NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENTS (CRADA) WITH INDUSTRY AS A VALUE ENHANCING ASSET IN THE ACADEMIC/RESEARCH ENVIRONMENT. A CASE STUDY AT THE NAVAL POSTGRADUATE SCHOOL (NPS)

by

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September 2005

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Cooperative Research and Development Agreements (CRADAs) are used by federal laboratories to participate in collaborative efforts and partnerships with industry. Although not technically a research laboratory, the Naval Postgraduate School (NPS) is a federally funded research university that has developed an extensive sponsored program of Technology Transfer (T2) with the private sector. Cooperative research and development is often a two-way instrument, where knowledge-generated value can flow in both directions. This thesis research will assess that value, from the perspective of the federal partner, based on the NPS case as a specialized academic and research institution.

The research and analysis performed within the context of this thesis contributes to goals established in the NPS "Technology Transfer Business Plan", focusing on the measurement of outcomes and benefits resulting from CRADAs, one of the preferred and most widely used mechanisms in technology transfer within the domain of DoD and particularly at the NPS. The perspective chosen, in the direction from the non-federal entity—generally industry—towards the federal partner, has not been researched and reported in the specialized literature as extensively as in the opposite direction.

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TABLE OF CONTENTS

I. INTRODUCTION....1
A. BACKGROUND....1
B. OBJECTIVES....2
C. RESEARCH QUESTIONS....4
1. Primary Research Question....4
2. Secondary Research Questions....4
D. SCOPE LIMITATIONS AND ASSUMPTIONS....5
1. Scope....5
2. Limitations....5
3. Assumptions....5
E. LITERATURE REVIEW....6
F. METHODOLOGY....8
1. Establishment of Evaluation Criteria....9
2. Data Collection....9
3. Data Analysis and Report....10
G. DEFINITIONS AND ABBREVIATIONS....10
H. ORGANIZATION OF THE THESIS....11
1. Chapter I: INTRODUCTION....12
2. Chapter II: TECHNOLOGY TRANSFER....12
3. Chapter III: THE COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENT (CRADA)....12
4. Chapter IV: TECHNOLOGY TRANSFER AT THE NAVAL POSTGRADUATE SCHOOL....12
5. Chapter V: DEVELOPMENT OF EVALUATION CRITERIA AND METRICS....12
6. Chapter VI: ANALYSIS AND ASSESSMENT OF SELECTED CRADAS AT THE NAVAL POSTGRADUATE SCHOOL....13
7. Chapter VII: CONCLUSIONS AND RECOMMENDATIONS....13
8. APPENDICES....13

II. TECHNOLOGY TRANSFER....15
A. DEFINITION....15
B. TECHNOLOGY TRANSFER ENTITIES....18
1. Technology Transfer Organizations....20
2. Technology Transfer Programs....21
3. Technology Transfer (T2) Mechanisms....23
C. TECHNOLOGY TRANSFER LEGISLATION....25
1. Main Legislation....25
2. Other Legislation....28
D. TECHNOLOGY TRANSFER IN DOD AND DON....28
1. Department of Defense (DoD)....29
2. Department of the Navy (DoN)....30
E. TECHNOLOGY TRANSFER IN UNIVERSITIES....30

III. THE COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENT (CRADA) 33
A. BACKGROUND 33
B. DESCRIPTION 34
C. LEGAL FRAMEWORK 35
D. THE CRADA PROCESS 37
1. Concept Definition 38
2. Draft 39
3. Review of CRADA Draft 39
4. Formal Negotiations 40
5. Final Negotiations and Signature 40
6. Agency Review (ONR on behalf of the Department of the Navy) 40
7. CRADA Execution 41
8. CRADA Termination and Closure 41
E. THE "MODEL" CRADA 42
F. PARTICULAR CONSIDERATIONS IN THE DOD/DON ENVIRONMENT 42
1. Department of Defense 42
2. Department of the Navy 43
G. BENEFITS RESULTING FROM CRADAS 45

IV. TECHNOLOGY TRANSFER AT THE NAVAL POSTGRADUATE SCHOOL 49
A. BACKGROUND 49
1. Academic Schools 50
2. Institutes 50
3. Research Centers 50
B. ORGANIZATIONS 52
1. Research and Sponsored Programs Office (RSPO) 52
2. NPS Research Board 53
3. Office of General Counsel Representative (OGC) 54
4. NPS Foundation Transformation Center (TC) 54
C. RESOURCES 54
Small Business Innovation Research (SBIR) Site 55
D. THE NPS TECHNLOGY TRANSFER PROGRAM (TTP) 55
1. Cooperative Research and Development Agreements (CRADAs) 55
2. Patents 55
3. Publications 56
4. Memoranda of Understanding (MOU) and Memoranda of Agreement (MOA) 56
5. Consortia 56
6. Work for Others 56
E. TECHNOLOGY TRANSFER PROGRAM (TTP) OBJECTIVES 57
F. CRADAS AT NPS 58

V. DEVELOPMENT OF EVALUATION CRITERIA AND METRICS 61
A. INTRODUCTION 61
Why—and When—Assess T2 Programs? 63
B. PROPOSED EVALUATION CRITERIA 64
Effectiveness Evaluation Criteria 65
C. SUPPORT FOR THE PROPOSED EVALUATION CRITERIA 69
1. Scientific and Technical (S&T) Capability 69
2. Research Quality 70
3. Academic Impact and Curricular Impact 70
4. Political-Strategic 71
C. METRICS 71

VI. ANALYSIS AND ASSESSMENT OF SELECTED CRADAS AT THE NAVAL POSTGRADUATE SCHOOL 75
A. INTRODUCTION 75
B. DATA COLLECTION 75
C. THE FACULTY SURVEY 76
1. Sample Selection 76
2. Pilot Survey 78
3. Full-Set Survey 78
4. Survey Structure 78
D. DATA ANALYSIS AND ASSESSMENT 80
1. Scientific and Technical (S&T) Capability 81
2. Research Quality 83
3. Academic Impact 88
4. Curricular Impact 90
5. Political-Strategic 91

VII. CONCLUSIONS AND RECOMMENDATIONS 95
A. CONCLUSIONS 95
1. Effectiveness Evaluation Criteria and Metrics 95
2. Technology Transfer, Information and Intellectual Property 96
3. Trusted Relationships 98
4. Marketing of Technology Transfer at NPS 100
5. Procedural Aspects of CRADAs 101
B. ANSWER TO RESEARCH QUESTIONS 103
1. How effective have been Cooperative Research and Development Agreements (CRADAs) in generating value for the federal partner (NPS)? 103
2. What metrics are appropriate to measure the institutional value generated by CRADAs in the academic/research environment, particularly for the federal partner? 104
3. Based on the previous analysis, what recommendations can be made to complement and enhance the CRADA process? 106
C. RECOMMENDATIONS 106
1. Processes and Best Practices 106
2. Curricular Impact and Industry Sponsored Programs 110

3. Innovative Marketing of Technology Transfer Opportunities....111
4. Tools and Technology Support (IT).....112
5. Organizational Issues.....113
D. SUGGESTIONS FOR FURTHER RESEARCH.....114
E. FINAL CONCLUSION.....115

LIST OF APPENDICES.....117
A. APPENDIX A:.....117
B. APPENDIX B: SURVEY QUESTIONNAIRE DATA TABLES AND CHARTS.....117
C. APPENDIX C: SUMMARY OF REQUIREMENTS FROM DON LABORATORIES AND/OR TECHNICAL ACTIVITIES TO ENTER INTO CRADAS (FROM SECNAVINST 5700.16A).....117
D. APPENDIX D: NAVY STANDARD MODEL CRADA.....117
E. NPS TECHNOLOGY TRANSFER BUSINESS PLAN.....117
F. ONR NAVAL TECHNOLOGY NEEDS CODES.....117

LIST OF REFERENCES.....119

INITIAL DISTRIBUTION LIST.....215

LIST OF FIGURES

Figure 1: Basic Entities of the Technology Transfer Process. 18
Figure 2: Technology Transfer Entities in a Collaborative Setting. 19
Figure 3: Navy CRADA History (Vincent, 2004, p. 4). 34
Figure 4: The DoN CRADA Process (ONR, 2005a). 37
Figure 5: Number of CRADAs entered into by NPS (year indicates starting of process) 59
Figure 6: Attainment of Research and Academic CRADA Objectives. 85
Figure 7: Benefits Realized through the CRADA. 86
Figure 8: Alternatives to CRADAs for Accomplishing the Research Objectives. 88
Figure 9: Student Related Work as a Result of CRADA Activity 89

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LIST OF TABLES

Table 1: Technology Transfer Mechanisms in the Federal Sector (FLC, 2004, pp. 1-18 1-22). 24
Table 2: What a CRADA Is and What it Is Not (ONR, 2005a)....35
Table 3: Mapping of Content from the FLC "Model" CRADA to the Navy "Standard" CRADA....45
Table 4: Bozeman's Effectiveness Evaluation Criteria and Key Questions....65
Table 5: Transformation of Bozeman's Criteria to the Proposed set of Criteria. 66
Table 6: Proposed Effectiveness Evaluation Criteria and Key Questions for the NPS academic/research environment. 67
Table 7: Rationale for Proposed Effectiveness Evaluation Criteria. 68
Table 8: Proposed Information Requirements and Metrics. 73
Table 9: Thematic Organization of the Questionnaire and Specific Information Provided. ...79
Table 10: Mapping of CRADA Subject Technologies to ONR Naval Technology Needs....83
Table 11: Differences between Navy Standard and Non-Standard CRADAs....107

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I. INTRODUCTION

A. BACKGROUND

Cooperative Research and Development Agreements (CRADAs) have become the mechanism of choice for accomplishing research and development (R&D) collaborative partnerships between federal and non-federal entities, particularly within the Department of Defense (DoD) domain. The apparent success of CRADAs has been attributed to multiple reasons ranging from pure administrative and regulatory issues to more specific aspects related to its robust applicability and suitability across a broad set of scenarios in the *technology transfer* environment.

Flexibility, ease of implementation, and reduced administrative overhead are normally cited as typical benefits of the CRADA mechanism. CRADAs are neither procurement contracts nor federal grants and therefore are not regulated by the complex Federal Acquisition Regulations (FAR, 2005); competitive bidding, for example, is not required. CRADAs were designed from the start to be flexible across multiple industry sectors, and essentially to be developed and implemented much more expediently and rapidly than traditional contracts.

This flexibility and reduced administrative overhead are supposed to enhance and make more effective—and attractive—the technology transfer process between federal R&D entities and the private sector. The true "value" generated by the CRADA program, however, is hardly captured by measuring the *goodness* of the process from an administrative or bureaucratic point of view; CRADA-generated value—like the value generated by *any* other technology transfer mechanism—is measured by how well it accomplishes the movement of technologies from one intended organizational environment to another.

Scholars and experts in the field of technology transfer have consistently considered the measurement of the *effectiveness* of related programs a challenging endeavor[1]. An important part of the inherent difficulty in accurately assessing the

[1] Particularly Bozeman (2000), Rogers et al. (2000) and Gibson et al. (1996). Further discussion of this very important topic and additional references are provided in Chapter V.

effectiveness of a technology transfer program or activity is due to the multiple organizational settings where the program or activity develops and the many associated different expectations—and associated perceptions—of the associated entities and actors involved. Since technology transfer activities are normally two-sided undertakings, these perceptions could also differ significantly depending on which direction of the transfer is considered.

Discussions about technology transfer between the public and private sectors are normally based on the assumption that federally-generated scientific and technological developments are indeed transferred *from* the public *to* the private sector. Most of the existing legislation has been focused on this particular direction of the transfer[2]. However, the technology transfer process oftentimes happens *in reverse*, as technologies also move from the private to the public sector (RAND, 2003).

The Naval Postgraduate School (NPS) has accumulated over the years a vast repository of experience and know-how in the area of technology transfer through an extensive research program, which includes a very active CRADA component. Using that repository of information as a first-hand source, the research, analyses, and results presented in this thesis will try to develop a better understanding of useful metrics to assess the effectiveness of CRADA programs, in the peculiar environment of the NPS as a (federally funded) highly specialized research and educational institution.

This study fits within the broader domain of technology transfer and particularly in the area of collaborative research and development among federal (DoD) and private partners. Given the specific nature of the Naval Postgraduate School (NPS) as an educational institution it also pertains to the realm of university-industry partnerships.

B. OBJECTIVES

Technology transfer (T2) is indeed a *bidirectional* activity. There have been many occasions when technology transfer mechanisms have been used effectively by the

[2] This complex body of legislation started with the *Stevenson-Wydler Technology Innovation Act of 1980* (Public Law 96-480) and continued throughout the 80s and 90s. Further details are provided in Chapter II.

federal partner (be it a laboratory, a test and evaluation facility, an engineering and logistics support center, or an educational institution like the Naval Postgraduate School) to *bring in* added value. This value has resulted from the sharing of knowledge and expertise with the private sector, particularly through cooperative endeavors. The Federal Laboratory Consortium for Technology Transfer (FLC) *Federal Technology Transfer Legislation and Policy* (also known as the "Green Book"), for example, refers to this *bidirectional sharing* of resources between federal laboratories and private industry when addressing the goal of the extensive legislation that has been enacted by Congress for this purpose (FLC, 2002).

It is specifically in this field—technology transfer—and looking at that particular *direction*—from the private to the public sector—where this thesis research will focus, trying to capture and evaluate CRADA *effectiveness* as a value-enhancing activity in the attainment of the institutional goals for the federal partner (in this case the NPS as a specialized research/educational institution). This will be done by compiling and analyzing data from the extended base of knowledge and experience that has accumulated in the school after participating in this kind of programs for over a decade.

The expected outcomes from this research should provide insight into value-creation in the CRADA process. How this value can be measured and also how the process can be enhanced to generate additional value. The NPS Technology Transfer Business Plan (NPS, 2003a), which is available from the NPS webpage[3], specifically states that:

> Performance measures for the Technology Transfer Program will be more clearly defined within the next year. Outside of the performance measurements for the NPS Research Program and the scholarly activity of the faculty, there needs to be criteria which lend themselves specifically to Technology Transfer. The Associate Provost and Dean of Research, the ORTA and the NPS Research Board will undertake this initiative (NPS, 2003a).

The research and analysis performed within the context of this thesis will contribute to that goal, focusing on the measurement of outcomes and benefits resulting

[3] Available at http://www.nps.navy.mil/Research/techtran-plan.html.

from CRADAs, one of the preferred and most widely used mechanisms in technology transfer within the domain of DoD and particularly at the NPS. The perspective chosen, in the direction from the non-federal entity—generally industry—towards the federal partner, has not been researched and reported in the specialized literature as extensively as in the opposite direction. The previous student thesis developed about this topic, dates back to 1993 when the first CRADA was drafted at the NPS.

C. RESEARCH QUESTIONS

One primary and two secondary research questions have been established for this thesis. They were developed and refined during the preparation of the *thesis proposal.* The initial document and literature review, and some preliminary interviews with key stakeholders provided the necessary background into the broad area of technology transfer and particularly into cooperative endeavors. The measurement and evaluation of program effectiveness soon became a key issue and a valid candidate for useful research. Furthermore, the research area was accordingly scoped and narrowed to provide a manageable and self-contained topic.

1. Primary Research Question

How effective have Cooperative Research and Development Agreements (CRADAs) been in generating value for the federal partner (NPS)?

2. Secondary Research Questions

What metrics are appropriate to measure the institutional value generated by CRADAs in the academic/research environment, particularly for the federal partner?

Based on the previous analysis, what recommendations can be made to complement and enhance the CRADA process?

D. SCOPE LIMITATIONS AND ASSUMPTIONS

1. Scope

This thesis will only look in detail at the CRADA mechanism and just in general terms to other technology transfer programs and mechanisms as a framework for the analysis. Additionally, the main focus for the research is on the private-to-public direction (although some selected aspects of the opposite direction will also be eventually reviewed, as necessary to support particular research topics), specifically in collaborative environments and endeavors.

Although, the NPS CRADA program includes partners from a broader domain (public and private academic institutions, Federal, State and local agencies and nonprofit organizations), this thesis will only look at those CRADAs where the non-federal partner is industry.

2. Limitations

The basic set of data collected and analyzed to support this research will come exclusively from the extensive information on CRADAs available in the Research and Sponsored Programs Office (RSPO) of the NPS and from internal (within the School) and external (industry partners) interviews and surveys. In principle, the results of this research will then be valid only in that specific domain: Federal-DoD-Research-University. The peculiar characteristics of the NPS and their impact on the broader applicability of the conclusions will thus be pondered.

3. Assumptions

The main data collection task supporting this research will be a three-pronged effort, through (1) an extensive document review subtask, (2) a set of in-depth direct interviews with selected key stakeholders in the CRADA process, and (3) a set of electronically formatted and submitted questionnaires administered to the “bottom-line” direct participants in the CRADAs—namely faculty and industry partners. In the latter

two cases, there is a critical assumption that is being made regarding the interview/questionnaire technique:

> [That] the characteristics or beliefs can be described or measured accurately through self-report. In using questionnaires, researchers rely totally on the honesty and accuracy of participants' responses (Marshall & Rossman, 1999, p. 129).

There are certain mechanisms (particularly the review of documents) which allow the cross-examination of certain responses. However, no effective mechanisms allow the accurate verification of *all* types of responses (for instance, those based on self-reported accomplishment of objectives), therefore this assumption holds.

E. LITERATURE REVIEW

There is an important literature base focused on the evaluation of technology transfer programs from the perspective of the non-federal partner—mainly industry. Some examples include (see list of references and bibliography at the end for detailed data on publications):

- Gibson et al. (1996), in "Customer Assessment of CRADA Program Performance", provide a survey-based approach into measuring program performance, focusing on perceptions of the industry partner. The CRADA process and outcomes are benchmarked and all results are categorized for small, mid-size and large companies.

- Rogers et al. (1998), in "Cooperative Research and Development Agreements (CRADAs) as Technology Transfer Mechanisms", present an interesting study on the specific difficulties that the partners in a CRADA normally face, and how those difficulties affect the outcome of the CRADA. It also includes comparative analysis between U.S., German and Japanese practices.

- Bozeman (2000), in "Technology Transfer and Public Policy: A Review of Research and Theory", provides an in-depth and focused review and analysis on the effectiveness and impact of U.S. domestic technology transfer efforts from universities

and government laboratories, using specific criteria such as market impact, political effectiveness and capacity-building.

On the other hand, not much has been written about the evaluation of performance of technology transfer programs in the other direction, from industry towards the federal partner, particularly within the DoD environment; a few examples include:

- A comprehensive study entitled "DoD Cooperative R&D Agreements: Value Added to the Mission" by Booz, Allen and Hamilton (1999) presents an outstanding analysis designed to evaluate a sampling of DoD CRADAs to assess the specific benefits that DoD gets from participation in such agreements.

- McDonald (1996), in "Cooperative Research and Development Agreements (CRADA): Are They Value Added?", provides immediate and long-term benefit analysis—with a focus on an industry-wide perspective and policy-related recommendations.

The study of industry-university partnerships in technology transfer has also been extensively documented, some examples include:

- Rogers et al. (2000), in "Assessing the Effectiveness of Technology Transfer Offices at U.S. Research Universities", develop and measure technology transfer effectiveness as related to the degree to which research-based information is moved successfully from universities to private companies.

- A report by the Council on Governmental Relations (COGR) entitled "Technology Transfer in U.S. Research Universities: Dispelling Common Myths" (COGR, 2000a) and their "Tutorial on Technology Transfer in U.S. Colleges and Universities" (COGR, 2000b) provide an excellent description of the standard processes and a brief analysis of their contribution to the university mission.

- Stephan (2001), in "Educational Implications of University-Industry Technology Transfer", examines the potential that technology transfer activities have for affecting changes, both positively and negatively, in programs and curricula.

- Coleman and Shelnutt (1995), in “Fostering University-Industry Partnerships through Sponsored Undergraduate Design”, describe in detail a mechanism by which industrial partners sponsor real-world design projects that generate substantial benefits for both the industrial and academic communities.

- Williams (2002), in “Creating Partnerships with Power”, analyzes organizational and cultural obstacles that need to be overcome for university-industry partnerships to be successful.

At the Naval Postgraduate School (NPS) two previous student theses have explored and documented available mechanisms and programs to carry out collaborative research and development (R&D) activities between DoD organizations and industry:

- Morgen (1993), in “Cooperative Research and Development Agreement (CRDA)”, discusses the essential elements of a CRADA and presents an analysis of benefits for the government laboratory and its personnel (inventors) which can be realized using this mechanism. This work has particular “historical” value since, as part of his thesis effort, the student-author participated in the design, negotiations, drafting and execution of the first CRADA entered into by the NPS in 1992: “Thermoacoustic Refrigeration Systems” (CRADA-91-NPS-001).

- John (2001), in “Department of Defense and Industry: A Healthy Alliance”, presents a comprehensive description of available collaborative programs which DoD can use to leverage resources and technology with industry.

F. METHODOLOGY

A methodology suggested by O’Keefe (1982), particularly tailored to the technology transfer environment, will be used. This approach, like most evaluation procedures, includes three major elements: (1) establishing specific evaluation criteria [and metrics], (2) gathering the necessary data, and (3) performing the consequential analysis to make judgments of value, to support the goals of the evaluation effort.

1. Establishment of Evaluation Criteria

Establishing the evaluation criteria is arguably the most critical part of the complete evaluation process. Once the purpose of the study has been characterized and framed in terms of the research questions, the specific evaluation criteria—against which program success (or lack thereof) will be assessed—should be defined. O'Keefe suggests that the "Technology Transfer application plan" (O'Keefe, 1982, p. 55) should be the framework. In the case of the NPS, there is an equivalent document, the *Technology Transfer Business Plan* (NPS, 2003) which is used. The Schools' Strategic Plan: A *View to the Future: The Naval Postgraduate School* (NPS, 2004a) also contains essential high-level policy (vision, principles and strategic initiatives) which is explicitly pertinent to the technology transfer program objectives.

2. Data Collection

Three primary data collection methods will be used: (1) document review, (2) in-depth direct interviews, and (3) self-report electronic questionnaires (as defined by Marshall & Rossman, 1999, pp. 116-117 and 129-131). Methods (2) and (3) will be administered to a number of selected stakeholders

The document review task will be based on the analysis of a number of representative CRADAs selected from the existing NPS archives available at the RSPO, and also a review and analysis of the essential School policy documents previously mentioned. During this phase the relevant stakeholders in the process will also be identified. On the NPS side this will likely include School leadership and staff, technology transfer and research staff, academic leadership—school deans, department chairs and institute directors—general faculty and staff, legal counsels, and students, wherever applicable. On the industry side, the corresponding organizational partners will also be identified.

The in-depth direct interviews will be conducted personally with selected stakeholders, where appropriate. This selected sample will initially include staff from the RSPO; school, department, and institute leadership; and the NPS legal counsel.

Finally, the survey questionnaire will be administered to selected stakeholders (as identified in the document review) in indirect-electronic form. The questionnaire's content will also be guided by observations and insights resulting from the document review, by the evaluation criteria and ultimately by the research questions. It will include a combination of open-ended and structured questions designed to provide both qualitative and quantitative data. Although the specific emphasis of this research is in the non-federal to federal direction of the CRADA, first-hand information will also be collected from the external (industry partner) side of the agreement.

3. Data Analysis and Report

Data analysis constitutes the final step in this methodology, where the collected data will be used to make judgments against the evaluation criteria previously defined. Three basic steps are required (Punch, 2003): (1) summarizing and reducing the data—including "data cleaning"—into variables, (2) descriptive level analysis of the variables and "variability" across the sample and (3) relationships analysis among the observed variables.

O'Keefe asserts that as a result of this judgment it should be "possible to determine not only program success or failure but also the reasons for that result" (O'Keefe, 1982, p. 55). That notion supports the development of the answer to the last [secondary] research question, regarding recommendations that can be made to complement and enhance the CRADA process, to include best practices, tools and supporting technologies and organizational issues.

G. DEFINITIONS AND ABBREVIATIONS

1. Cooperative Research and Development Agreement

> Any agreement between one or more Federal laboratories and one or more non-Federal parties under which the Government, through its laboratories, provides personnel services, facilities, equipment, intellectual property, or other resources with or without reimbursement (but not funds to non-Federal Parties) and the non-Federal parties provide funds, personnel, services, facilities, equipment, intellectual property, or other resources

toward the conduct of specified research or development efforts which are consistent with the missions of the laboratory (15 USC 3710a (d) (1) as cited in FLC, 2002, p. 32).

2. Federal Laboratory

A facility or group of facilities owned, leased, or otherwise used by a Federal agency, a substantial purpose of which is the performance of research, development, or engineering by employees of the Federal Government (15 USC 3710a (d) (1) as cited in FLC, 2002, p. 32).

3. Partnership Intermediary

The term 'partnership intermediary' means an agency of a State or local government, or a nonprofit entity owned in whole or in part by, chartered by, funded in whole or in part by, or operated in whole or in part by or on behalf of a State or local government, that assists, counsels, advises, evaluates, or otherwise cooperates with small business firms, institutions of higher, or educational institutions, that need or can make demonstrably productive use of technology-related assistance from a Federal laboratory, including State programs receiving funds under cooperative agreements entered into under section 5121(b) of the Omnibus Trade and Competitiveness Act of 1988 (15 USC 3715 (c) as cited in Cornell, 2005).

H. ORGANIZATION OF THE THESIS

The thesis is organized into seven chapters followed by six appendices containing relevant supporting documents and data. The details regarding the particular implementation of the selected methodology described above, together with the presentation of the data collected, its analysis and the resulting outcomes and final recommendations will be presented in the last three chapters of the thesis.

Additionally, in order to provide for an adequate background in the subject matter and the necessary framework to put the analysis into the appropriate context, a brief introduction to the area of *technology transfer*—and particularly to *collaborative* endeavors, in the general and specific (NPS) domains considered—will be presented in the next three chapters. Relevant issues from statutory and regulatory policy and guidance will also be introduced.

The chapters are organized as follows:

1. Chapter I: INTRODUCTION

This chapter gives the basic background for the thesis and the methodology used in developing the research, including a brief literature review.

2. Chapter II: TECHNOLOGY TRANSFER

This chapter introduces the concept of "technology transfer" as a framework for the CRADA mechanism. A summary of the salient legislation is presented, and finally the particular aspects of technology transfer in the specific sub-domains considered are highlighted (DoD and academia).

3. Chapter III: THE COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENT (CRADA)

This chapter presents the details of the CRADA mechanism, process and the supporting legal framework. Department of Defense (DoD) and Department of the Navy (DoN) policy and guidance is also highlighted.

4. Chapter IV: TECHNOLOGY TRANSFER AT THE NAVAL POSTGRADUATE SCHOOL

This chapter presents organizational and procedural aspects of technology transfer programs and activities in general and CRADAs in particular at the NPS. The School's "Technology Transfer Business Plan" (NPS, 2003) is introduced and analyzed.

5. Chapter V: DEVELOPMENT OF EVALUATION CRITERIA AND METRICS

Based on the "document review" and "data collection" tasks, evaluation criteria and specific metrics are presented and supported in this chapter. These criteria and metrics will be used in Chapter VI to drive the analysis and results.

6. Chapter VI: ANALYSIS AND ASSESSMENT OF SELECTED CRADAS AT THE NAVAL POSTGRADUATE SCHOOL

This chapter presents in detail the data collected through the questionnaire and interview responses and a subsequent analysis which puts that information into context.

7. Chapter VII: CONCLUSIONS AND RECOMMENDATIONS

In light of the preceding chapter analysis and assessment, this chapter presents the most important results in summary form and the associated recommendations. Suggestions for further research are also included.

8. APPENDICES

a. APPENDIX A: QUESTIONAIRE SAMPLES

1) A1: FACULTY (PI) SURVEY QUESTIONNAIRE

2) A2: INDUSTRY PARTNER SURVEY QUESTIONNAIRE

b. APPENDIX B: SURVEY QUESTIONNAIRE DATA TABLES AND CHARTS

c. APPENDIX C: SUMMARY OF REQUIREMENS FROM DON LABORATORIES AND/OR TECHNICAL ACTIVITIES TO ENTER INTO CRADAS (FROM SECNAVINST 5700.16A)

d. APPENDIX D: NAVY STANDARD MODEL CRADA

e. APPENDIX E: NPS TECHNOLOGY TRANSFER BUSINESS PLAN

f. APPENDIX F: ONR NAVAL TECHNOLOGY NEEDS

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II. TECHNOLOGY TRANSFER

A. DEFINITION

Before probing into cooperative R&D agreements and their value—and the inherent difficulties in measuring "value" in this context—it is useful to put the CRADA mechanism in context within its larger frame of reference: technology transfer. While a CRADA is a very specific mechanism established by U.S. law to enable and regulate the utilization of federally owned or originated technology by State and local governments and the private sector (and hence, there is a very precise and unequivocal definition for the term), "technology transfer" is a universal concept. Accordingly, there is not nearly the same degree of accord when trying to define it. Most sources look at it as a "process", and still some others see it as a "product". Sometimes it entirely takes place within a single organization and some other times it spans across nations and even supranational organizations.

More than 30 years ago, in the preface to his book *Technology Transfer: Successes and Failures*, Manning (1974, p. v) expressed:

> Few expressions represent so many different meanings to so many different people as does the often-used phrase "technology transfer". Educators may think of the teacher-pupil relationship with which they have been associated ... Engineers may think of sophisticated turnkey plants in developing countries. Researchers may think of new applied research laboratories … Perhaps the only view with which all would agree is that technology transfer is inherently good; that when it occurs some economic or social benefit accrues to at least a small segment of mankind.

To a large community of experts "technology transfer" is a critical *internal* enterprise process, as when a technology developed for a particular application in one area of the company—i.e., design—can be successfully transferred into another, for example, manufacturing. Still to others it has a completely *external* and farther outreaching meaning: "technology transfer represents the single most important hope of alleviating the ever widening gap between the haves and have-nots in the world" (Coskun Samli, 1985, p. xiii). The literature about "international" technology transfer (as in

technology transfer to underdeveloped Latin American countries or within the European Union) is massive; as a matter of fact, this category alone makes up for the bulk of the existing literature on the subject at the NPS library.

As a result of the theoretical breadth of the concept of technology transfer, many definitions are available in the vastly abundant literature on the subject. All of these definitions present some "flavor" of technology transfer, depending on the context. Three good *working* definitions are presented here, which are closer and more focused on our approach to the subject. The first one is very general and broad in scope, the second is more specific to the public-private setting, and finally the third definition is particular to the military environment:

- Roessner (as cited in Bozeman, 2000, p. 629) defines it as "the movement of know-how, technical knowledge, or technology from one organizational setting to another." Bozeman also adds:

> The term has been used to describe and analyze an astonishingly wide range of organizational and institutional interactions involving some form of technology related exchange. 'Sources' of technology have included private firms, government agencies, government laboratories, universities, nonprofit research organizations and even entire nations; 'users' have included schools, police and fire departments, small businesses, legislatures, cities, states and nations … Within single organizations such as large research-intensive private firms, technology transfer has been used to describe the processes by which ideas, proof-of-concept, and prototypes move from research-related phases to production-related phases of product development (Bozeman, 2000, p. 629).

- The Federal Laboratory Consortium for Technology Transfer *Technology Transfer Desk Reference* defines it as "the process by which existing knowledge, facilities, or capabilities developed under federal research and development (R&D) funding are utilized to fulfill public and private needs" (FLC, 2004, pp. 1-2).

- Finally, the Department of Defense Instruction 5535.8 entitled "DoD Technology Transfer Program" defines Technology Transfer (T2) as "the intentional communication (sharing) of knowledge, expertise, facilities, equipment, and other resources for application to military and nonmilitary systems" (DOD, 1999, p. 20). It

further adds that domestic technology transfer shall include: spin-off, spin-on and dual-use science and technology activities. “Spin-off” are T2 activities, the purpose of which is to promote and make available existing DoD-owned or -developed technologies and technical infrastructure to a broad spectrum of non-DoD applications. “Spin-on” activities are developed to incorporate innovative technology into military systems to meet mission needs. Finally “dual-use” activities are designed to develop technologies that have both DoD and non-DoD applications (DOD, 1999, p. 20).

As it will be seen in the next section on technology transfer legislation, the obvious intent when evolving and enforcing that complex body of legislation was to move technology out of [federally funded] laboratories and into domains where it could be applied to generate economic value, with the overarching objective goal of making the U.S. more competitive as a nation. Using this approach it is entirely more intuitive to view technology transfer as a *unidirectional* process, where technology effectively flows from the public toward the private sector. However, having a broader perspective of what technology transfer really implies, the opposite direction (captured by some of the definitions) also becomes very obvious and valid, through the use of *collaborative* endeavors.

The Merriam-Webster Collegiate Dictionary defines collaborative (from collaborate) as “to work jointly with others or together especially in an intellectual endeavor”, and “to cooperate with an agency or instrumentality with which one is not immediately connected” (Merriam-Webster, 2002). Although not expressly stated, this *joint* nature of collaborative work obviously requires the realization of *mutual* benefits, which need to satisfy both *common* and *specific* objectives and interest of all participating “instrumentalities”.

The collaborative aspect of technology transfer is explicitly captured in the aforementioned DoD definition of the term by the *spin-off spin-on* duality. Furthermore, these *spin-on* activities have become critically important in modern times, where the private sector is clearly the *driving* force of technology development in most but a very small cluster of technologies.

B. TECHNOLOGY TRANSFER ENTITIES

The basic components of the technology transfer process can readily be identified by looking at the fundamental participating entities. **Figure 1** depicts the most basic T2 setting where a specific technology (the OBJECT of T2) is being transferred from an organization who owns it (the OWNER), likely but not necessarily its developer, to a recipient organization (the RECEIVER), where this technology will be used to produce some value (economic or otherwise). The specific T2 MECHANISM used to execute the transfer (CRADA, technical assistance, use of facilities, personnel exchanges, etc.) is the instrumental entity which allows the transfer to occur. Finally, the BROKER is a *liaison* organization designed to facilitate the transfer. The broker could be internal to any of the other two organizations —OWNER and RECEIVER—or both or none, i.e. an external entity. Although a liaison is commonly part of a T2 process, its existence and/or participation is not required.

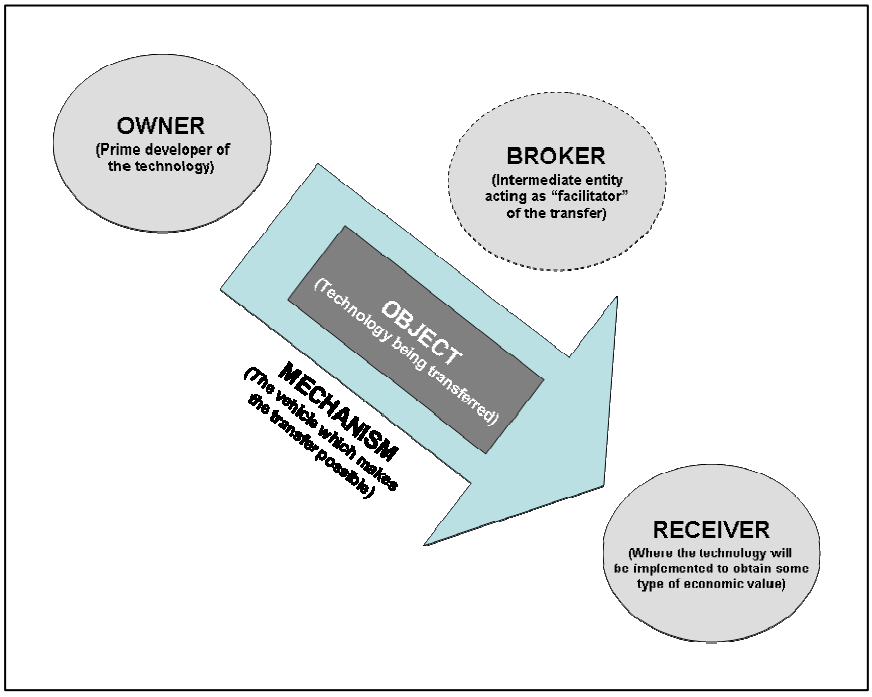

Figure 1: Basic Entities of the Technology Transfer Process.

A more comprehensive representation of the T2 process, to include the bidirectional nature of collaborative endeavors is depicted in **Figure 2** . In this case the direction of the arrow indicates that the technology is being transferred (and possibly co-developed) between both participating organizations, although this does not necessarily imply a symmetrical relationship, i.e., one of the organizations can gain *more* in the transfer. The MECHANISM used to execute the transfer (for example a CRADA) needs to support this type of exchange.

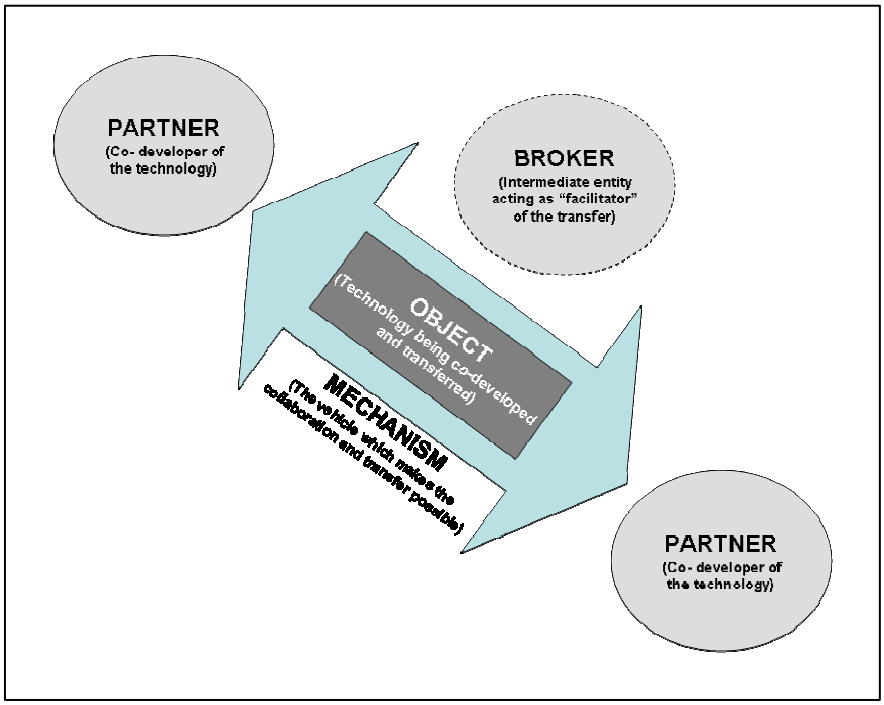

Figure 2: Technology Transfer Entities in a Collaborative Setting.

To illustrate the conceptual basic entities introduced above with real-world implementations, a brief overview of existing technology transfer organizations, programs and mechanisms is presented here:

1. Technology Transfer Organizations

These are typical examples of the BROKER entities mentioned in the preceding section. All of them are available to act as facilitators and provide the necessary connections required to effect technology transfer activities among the participant organizations (extracted from FLC, 2004, pp. 1-9 to 1-15):

a. Office of Research and Technology Applications (ORTA)

The Office of Research and Technology Applications (ORTA) is the focal point for technology transfer activities within each federal laboratory. 15 U.S.C 3710 (b) requires that each laboratory having 200 or more full-time equivalent scientific, engineering and related technical positions must establish an Office of Research and Technology Applications (ORTA). Each Federal Agency which operates or directs one or more laboratories must provide funding to sustain the technology transfer function at the agency and laboratories, to include the support for the ORTA.

The main functions of the ORTA are:

- To prepare application assessments for selected R&D projects that may have potential commercial application.
- To provide and disseminate information on federally-owned or developed technologies (products, processes and services) having potential economic value for the private sector and State and local governments.
- To cooperate with the National Technical Information Service (NTIS), the Federal Laboratory Consortium for Technology Transfer (FLC) and other organizations which link R&D resources to potential users in the private sector and State and local governments.
- To provide technical assistance to State and local government officials.
- To participate in regional, State and local programs designed to facilitate and stimulate technology transfer activities.

b. Federal Laboratory Consortium for Technology Transfer (FLC)

15 U.S.C 3710 (e) established the Federal Laboratory Consortium for Technology Transfer (FLC). The FLC is a nationwide network of more than 700 member research laboratories and centers from 17 federal departments and agencies that is dedicated to furthering, promoting, facilitating, coordinating and supporting (through assistance, advice, development of training courses and materials, etc.) technology transfer programs and activities in the U.S. The FLC's vision is:

> [To] actively promote the fullest application and use of federal research and development by providing an environment for successful technology transfer. The Consortium will be the recognized leader in maximizing collaborative research and the transfer of federal technologies to enhance the socioeconomic wellbeing of the nation in the global marketplace (FLC, 2004, p. 2-1).

c. Other Organizations

Many other similar organizations at the Federal, State and local government level and private sector have been created with particular technology transfer oriented functions. These include:

- National and Regional Technology Transfer Centers
- State and local centers and commissions.
- Intermediate and professional organizations like the[4]:
  - Technology Transfer Society (T2S)
  - Association of University Technology Managers (AUTM)
  - Licensing Executives Society (LES)

2. Technology Transfer Programs

Several technology transfer programs have been established by various laws to support specific technology transfer activities with businesses, universities and non-profit

[4] The Technology Transfer Society webpage is available at http://www.t2society.org/; the Association of University Technology Managers at http://www.autm.net/index.cfm; and the Licensing Executives Society at http://www.usa-canada.les.org/.

research organizations, the most important are (extracted from FLC, 2004, pp. 1-15 to 1-18):

a. Advanced Technology Program (ATP)

It is a competitive system for grants and awards focused on high-risk technologies that have potential for long-term benefits for the economy. There is no restriction for the size of the companies that can participate. No direct funding is provided for government agencies, universities or non-profit organizations, but they can participate in joint efforts or as subcontractors.

b. Dual-Use Science and Technology Program (DUS&T)

This program is intended to combine private industry and military R&D efforts to develop or enhance technologies which have potential use for both military and commercial application (dual-use technologies). These programs are investment partnerships conducted outside the Federal Acquisition Regulations (FAR), normally through cooperative agreements or other transactions for funding.

c. Small Business Innovation Research (SBIR)

Established by the Small Business Innovation Development Act of 1982, this program was designed to stimulate the commercialization of products and processes developed by small businesses using federal funding. SBIR contracts are awarded competitively to small businesses (less than 500 employees) which submit proposals in response to requests published by Federal agencies, or for businesses with ongoing relationships with an agency they may actually suggest a given topic which may be of interest for the agency's mission. The SBIR program is structured in three phases (I, II and III) with specific requirements, functionality and maximum authorized funding from the federal agency. There is very explicit policy and guidelines regarding interactions between SBIR programs and CRADAs, which will be seen in the next chapter.

d. Small Business Technology Transfer (STTR)

This is similar in essence to the aforementioned SBIR programs. The main differences are that STTR programs focus on Government-Owned Contractor-Operated (GOCO) rather than Government-Owned Government-Operated (GOGO) laboratories and that the applicants must include in the collaborative effort a small business *and* a university, non-profit research institution or a federally funded research center.

3. Technology Transfer (T2) Mechanisms

A number of mechanisms are available to facilitate technology transfer efforts from the public to the private sector. Each mechanism has its own peculiarities which make it more appropriate for a particular T2 setting and organizational context. The following table (**Table 1**) gives a brief overview of some of the most important mechanisms—details can be found in the FLC's Technology Transfer Desk Reference, Section I (FLC, 2004):

T2 Mechanism	Description
Cooperative Research	These mechanisms foster the leveraging of resources to conduct mutually beneficial R&D programs through collaborative partnerships (CRADAs are a particular type of cooperative research).
Intellectual Property (IP)	A very important T2 mechanism. It allows federal scientists and engineers to patent inventions and license them to companies for commercial application.
Incubators	Incubators are innovative T2 mechanisms which sponsor, assist and develop new businesses by providing facilities and expertise during the initial period of gestation for the private startup company.
Promotional Materials	These mechanisms are designed to promote T2 awareness among parties. They include presentations, newsletters, brochures, pamphlets, etc.
Personnel Exchanges	Exchanges of personnel (scientists, engineers, technicians, faculty, students, etc.) can greatly enhance the T2 process. It can also lead to follow-on collaborative activities.

Technical Assistance	In this case, a laboratory or facility provides knowledge, special equipment and/or facilities to be used for the benefit of the other partner.
Collegial Interchange, Conferences and Publications	Collegial interchanges involve the informal interchange of information among colleagues. Professional conferences, on the other hand include more formal presentations of research activities and results. Publication in refereed journals is one of the most important venues of T2.
Grants and Cooperative Agreements	These mechanisms allow the government to transfer funds or property to a recipient organization to support or stimulate R&D activity. Whereas grants entail little government participation, in cooperative agreements there exists a significant technical involvement of the federal partner.
Education Partnership Agreements	In this case, federal agencies carry out technology assistance or applications to support activities conducted by educational institutions. This may entail the loan and/or donation of excess equipment, availability of personnel and general curricular assistance.
Use of Facilities	By this mechanism, specialized—and often unique—facilities owned by the government are made available to the private sector, universities and other federal organizations.
Memorandum of Understanding(MOU) and Memorandum of Agreement (MOA)	These mechanisms are used to establish initial links conducting to T2 efforts. In many cases they are used between two government organizations.
Commercial Test Agreements	These mechanisms allow the government to sell, rent, or lend test equipment or materials. It is specifically stipulated that in doing so the government cannot compete with the private sector.
Partnership Intermediaries	A partnership intermediary is a mechanism designed to facilitate and assist private companies and federal laboratories to enter into T2 activities.
Alliances	Through nonbinding agreements, alliances provide informal tools to enhance technical capabilities for the member organizations.
Miscellaneous Mechanisms	Several other particular mechanisms are implemented by different federal agencies, generally tailored to specific legislation or regulations. This category includes the DoD “Other Transactions” mechanism, which are flexible agreements that cover any venue not included in the previous categories.

Table 1: Technology Transfer Mechanisms in the Federal Sector (FLC, 2004, pp. 1-18 1-22).

Although other cooperative research mechanisms exist (including collaborative R&D contracts and grants) CRADAs are the most widely used cooperative research and development mechanisms, and they will be presented in detail in the next chapter.

C. TECHNOLOGY TRANSFER LEGISLATION

This compilation of current legislation was extracted the Federal Laboratory Consortium for Technology Transfer (FLC) "*Federal Technology Transfer Legislation and Policy"* (FLC, 2002, p. vii-xi).

1. Main Legislation

a. Stevenson-Wydler Technology Innovation Act of 1980 (Public Law 96-480)

This is the first of a continuing set of laws passed by Congress to define and promote domestic technology transfer. The primary focus of the Stevenson-Wydler Act was on getting federal laboratories involved in the technology transfer process; it made a requirement for federal laboratories to participate actively in technical cooperation with the private sector and to separate a specific percentage of the laboratory's budget for technology transfer activities. The law also mandated the establishment of the Office of Research and Technology Application (ORTA) in each laboratory to coordinate and promote technology transfer programs and activities.

b. Bayh-Dole Act of 1980 (Public Law 96-517)

The Bayh-Dole Act established additional boundaries regarding patents and licenses granted for federally funded inventions. Small businesses, universities and non-profit organizations were allowed to obtain specific rights to inventions developed with federal funds.

c. Small Business Innovation Development Act of 1982 (Public Law 97-219)

The Small Business Innovation Development Act of 1982 established the Small Business Innovation Research (SBIR) program which required federal agencies to fund small business conducted R&D activities relevant to the agencies' missions.

d. Federal Technology Transfer Act of 1986 (Public Law 99-502)

This is the second major piece of legislation in domestic technology transfer. All federal laboratory scientists and engineers are required hereby to consider technology transfer activities an individual responsibility and therefore, this responsibility should become part of personnel performance evaluations. The law also instituted Cooperative Research and Development Agreements (CRADAs) to enable federal laboratories (initially Government-Owned Government-Operated or GOGO) to negotiate licensing agreements for patented inventions. It also allowed government-employees to share in royalties for their patented inventions.

e. Executive Order 12591 (1987)

Executive Order 12591 required agencies and laboratory leadership to act as conduits of information among federal laboratories, universities and private businesses. It also continued to promote commercialization of federally funded inventions allowing laboratories to grant patents as long as the government retains royalty-free licenses for use.

f. Omnibus Trade and Competitiveness Act of 1988 (Public Law 100-418)

The Omnibus Trade and Competitiveness Act of 1988 emphasized the need for increased public/private cooperation in realizing benefits of R&D, establishing a number of new organizations and services to facilitate the process.

g. National Competitiveness Technology Transfer Act of 1989 (Public Law 101-189)

The National Competitiveness Technology Transfer Act of 1989 provided complementary new guidelines for CRADAs, extending the authorization for Government-Owned Contractor-Operated (GOCO) laboratories to participate in these agreements.

h. National Institute of Standards and Technology Authorization Act for FY 1989 (Public Law 100-519)

The National Institute of Standards and Technology Authorization Act of 1989 allowed contractual considerations for intellectual property rights other than patents in CRADAs. It also allowed software developers to be eligible for technology transfer awards.

i. American Technology Preeminence Act of 1991 (Public Law 102-245)

The American Technology Preeminence Act of 1991 provided additional provision related to CRADAs, including the authorization of intellectual property exchanges as part of the agreements. It also allowed federal laboratories to provide excess equipment to educational institutions and non-profit organizations as a gift.

j. Small Business Research and Development Enhancement Act of 1992 (Public Law 102-564)

This legislation extended the duration of the SBIR program and increased the required percentage of an agency's budget to be allocated to SBIR and other similar programs. It also established a similar new program, the Small Business Technology Transfer Program (STTR).

k. National Department of Defense Authorization Act for FY 1994 (Public Law 103-160)

This Act extended the definition of a "federal laboratory" to include weapons production facilities of the Department of Energy (DoE).

l. National Technology Transfer and Advancement Act of 1995 (Public Law 104-113)

The National Technology Transfer and Advancement Act of 1995 amended the Stevenson-Wydler Technology Innovation Act to make CRADAs more attractive to both private businesses and federal laboratories. For businesses, it provided additional assurances regarding intellectual property issues whereas for federal laboratories it established higher financial rewards for federal employees who developed marketable technologies under a CRADA.

m. Technology Transfer Commercialization Act of 2000 (Public Law 106-404)

The Technology Transfer Commercialization Act of 2000 continued to enhance CRADA benefits for the private sector, extending licensing authority to include preexisting (created prior to the signing of the CRADA) government inventions as part of the transferable technologies.

2. Other Legislation

Other pieces of legislation that also deal specifically with technology transfer but are not as significant include:

- Cooperative Research Act of 1984 (Public Law 98-462)
- Trademark Clarification Act of 1984 (Public Law 98-620)
- Japanese Technical Literature Act of 1986 (Public Law 99-382)
- Defense Authorization Act for FY 1991 (Public Law 101-510)
- National Defense Authorization Act for FY 1993 (Public Law 102-484)

D. TECHNOLOGY TRANSFER IN DOD AND DON

Within the authority conferred by federal legislation, the Department of Defense (DoD) and the service components (Departments of the Army, Navy, and Air Force) have

designed and implemented specific supporting policy and guidance documents to drive their technology transfer efforts.

1. Department of Defense (DoD)

The Department of Defense has issued specific regulations and guidance to conduct its technology transfer activities. The two primary documents are:

a. DoD Directive (DODD) 5535.3 (May 21, 1999) "DoD Domestic Technology Transfer (T2) Program"

DODD 5535.3 (DOD, 1999b) implements, establishes policy, and assigns responsibility for DoD domestic T2 activities under 10 and 15 U.S.C. as they apply to the Department of Defense.

b. DoD Instruction (DODI) 5535.8 (May 14, 1999) "DoD Technology Transfer (T2) Program"

DODI 5535.8 (DOD, 1999a) implements policy, assigns responsibility, and prescribes procedures under DoD Directive 5535.3 for implementation of T2 programs.

These guidance and policy documents reflect that "technology transfer activities are integral elements of DoD pursuit of the DoD national security mission" (DOD, 1999b, p. 2) and accordingly, are mandated to "have a high-priority role in all DoD acquisition programs and are recognized as a key activity of the DoD laboratories and all other DoD activities that may use or contribute to domestic T2" (DOD, 1999b, p. 2).

Furthermore, DODI 5535.8 also includes a very important clarification of the definition of a *laboratory* (DOD, 1999a, p. 19), which extends the concept to a broader set of facilities, to include any organization that provides research, development, testing and evaluation (RDT&E) within DoD (this would certainly include—although they are not explicitly mentioned—educational institutions like the Naval Postgraduate School and the Air Force Institute of Technology):

> [The] definition is not confined to those DoD Components that are formally titled "laboratories." The intent of that definition is to encompass the wide range of organizations and arrangements that function as laboratories and/ or technical activities in DoD research, development, and engineering programs. It shall include laboratories and/ or technical activities and reference more diverse arrangements that shall provide a virtual laboratory capability (DOD, 1999a, p.19).

2. Department of the Navy (DoN)

The Department of the Navy specific policy direction and guidance, in line with the abovementioned DoD documents, is contained in the Secretary of the Navy Instruction (SECNAVINST) 5700.16A (March 7, 2000) *"Domestic Technology Transfer (T2)"* (DON, 2000). This document will be further analyzed in the next chapter, since it particularly deals with CRADAs, providing very explicit and detailed guidance.

E. TECHNOLOGY TRANSFER IN UNIVERSITIES

The "Tutorial on Technology Transfer in U.S. Colleges and Universities" compiled by the Council on Governmental Relations (COGR) states that a university's primary contribution to society is the creation and dissemination of knowledge through teaching and research. This is done

> … in a variety of ways such as traditional teaching and publishing and less traditionally, perhaps, by engaging in collaborative research with industrial companies, by exchanging personnel, materials, and equipment with profit-sector companies, and also by licensing patented university inventions and other forms of new technology to industry for commercialization (COGR, 2000b, p. 1).

There are many models for university/industry *partnerships*, and most of them involve some form of technology transfer. Licensing university-patented technologies or inventions has become an important source of income for most large universities; nevertheless, that is just a small sample of the many successful technology transfer activities developed by almost all research universities nowadays. As a matter of fact, "doing technology transfer is an integral part of being a first-rate research university" (Tornatzky & Bauman as cited in Rogers et al., 2000, p. 6).

Success stories from companies that have benefited enormously from thriving partnerships with universities are abundant and well documented. However, not all industry-university partnerships have been completely successful. Williams (2002), in "Creating Partnerships with Power", states that "historically, universities have not been good partners, and industries have shied away from becoming involved with universities for a variety of reasons" (Williams, 2002, p. 1). Among the main reasons that have hampered industry-university partnerships, Williams (2002) indicates:

- Universities' restrictive purchasing policies.
- Conflicting schedules.
- Project and administrative personnel turnover.
- Generally, a lack of long term commitment and understanding for the different drivers of the economic cycle for private companies (particularly time-to-market pressure).

On the other hand, universities have also reaped great benefits from partnering with industry, not only financially but also by allowing research and education to be enriched by real-world experience and practical application skill. In many instances, a closer link with industry has also permitted universities—and this benefit is immediately transferred to the students—to more closely shape their educational offerings to what the real-world is demanding from new generations of professionals.

Industry-university partnerships have also been strongly criticized in some academic environments. The main complaints are that in some instances, too close a relationship with industry has diverted universities from their essential mission: education and research, or that as a result of the relationship with industry, universities have ended up being more interested in patenting and selling inventions than in publishing research findings for public use. For any of these arguments there is—as expected—a counterargument; nonetheless, organizational and cultural differences need to be addressed and taken into consideration to keep the right balance among competing obligations and demands across organizational boundaries.

Properly designed and executed industry-university partnerships, particularly in the area of technology transfer, can be exceptional opportunities for the attainment of mutually beneficial gains.

III. THE COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENT (CRADA)

A. BACKGROUND

The seminal piece of legislation for CRADAs was the Federal Technology Transfer Act of 1986 (Public Law 99-502), which enabled Government-Owned Government-Operated (GOGO) laboratories to enter into Cooperative Research and Development Agreements and to negotiate arrangements for patented inventions made at the laboratories. Through the years, this initial legislation was complemented and expanded to include broader coverage (Government-Owned, Contractor-Operated—GOCO laboratories), extended licensing authority for the federal party, and—consistently—the creation of additional incentives to make the mechanism more attractive for both parties, but especially for industry.

CRADAs have been developed in almost all areas, and among many different and varied public-private boundaries. Particular sectors of the Federal Government have been significantly more active (DoE, DoA and DoD, and also some independent Federal Administrations, notably NASA and NIH) but in every sector the trend is clear, and it shows that the "concept" and the legislation backing it were well received and apparently effective in accomplishing organizational goals for the parties involved.

The number of CRADAs can be used, if not as a direct measure of success for the mechanism, as an initial indicator of the interest it has generated among the participating entities. The following chart (**Figure 3**) shows the evolution of the number of agreements signed by the different Navy laboratories in the period 1989-2004[5].

[5] "Mini" CRADAs include "Technical Assistance" CRADAs and "Limited Purpose/Equipment" CRADAs. This category and also "Standard" and "Non Standard" CRADAs are further discussed in this chapter and in Chapter VII.

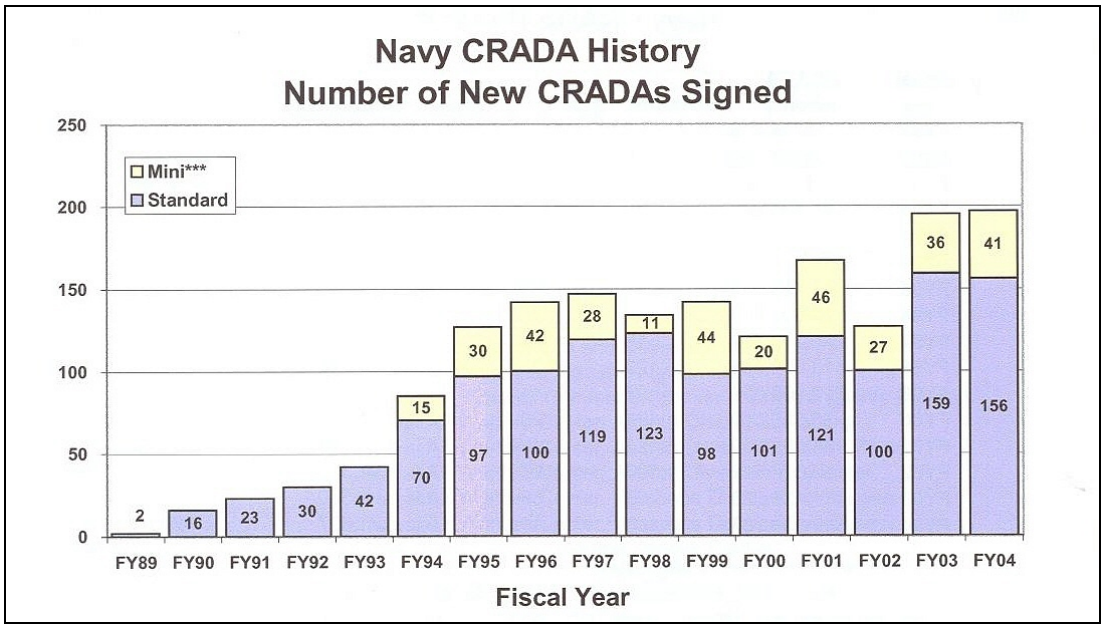

Figure 3: Navy CRADA History (Vincent, 2004, p. 4).

B. DESCRIPTION

A CRADA is a legal agreement used by (one or more) federal laboratories to engage in *collaborative* efforts with (one or more) non-federal partners to achieve specific goals of technology transfer. 15 USC 3710a (d) (1) (as cited in FLC, 2002, p. 32) defines a CRADA and specifically highlights:

- That the federal partner can contribute to the agreement: personnel, services, facilities, equipment, intellectual property, or other resources but specifically no funds to the non-federal partner (although it can use funds to support its own CRADA related work).

- That the non-federal partner can provide: personnel, services, facilities, equipment, intellectual property, or other resources and specifically funds to the federal-partner.

- That the work developed under the CRADA must be consistent with the missions of the laboratory.

A very helpful table (**Table 2**) is presented in the ONR "CRADA Online Course for the Office of Research and Technology Applications (ORTA)" which clarifies what a CRADA is and what it is not:

A CRADA is …	A CRADA is Not …
A legal contract for research & development.	An acquisition tool.
	A procurement vehicle subject to Federal Acquisition Regulation (FAR).
	A grant.
A collaborative effort with non-federal partners.	
A fund generating mechanism for the government.	A fund generator for private industry.

Table 2: What a CRADA Is and What it Is Not (ONR, 2005a).

Further into the course presentation slides (ONR, 2005a), it is stated that CRADAs can be used to support:

- Basic Research.
- Applied Research.
- Exploratory Developments.
- Production and Manufacturing Development.
- Evaluation of Commercial-Off-The-Shelf (COTS) equipment and materials.
- Technology Transfer to the Commercial Marketplace.

C. LEGAL FRAMEWORK

The statutory and regulatory framework for CRADAs is contained in the United States Code (U.S.C.) 15, Section 3710a. The salient points of this framework include (FLC, 2002, pp. 27-35):

- The designation and specific authority bestowed upon laboratory leadership to enter into CRADAs and to negotiate specific rights to intellectual property resulting from the agreement, on behalf of the federal agency.

- An enumeration of valid partners: other Federal, State and local agencies; industrial organizations; public and private foundations; non-profit organizations (including universities) or other persons.

- The extent of authorized exchanges which can be part of the transfer, in both directions; specifically funds, personnel, services and property from the non-federal party to the laboratory, and personnel, services and property—but explicitly not funds—from the laboratory to the non-federal party.

- The extent to which specific licensing and assignment of intellectual property resulting from the agreement can be granted on behalf of the Federal Government, subject to explicit conditions.

- A specific mandate regarding the preference and particular consideration which should be given to small business firms and consortia of small business firms located in the United States, also requiring that products resulting from inventions made under the CRADA shall be manufactured substantially in the United States.

- Other particular implementation issues, to include the consideration of potential conflicts of interest and standards of conduct for federal employees, and specific guidance and timelines for review and approval provisions.

- Finally, paragraph (g) of 15 U.S.C. 3710a (as cited in FLC, 2000, p. 33) enunciates two "guiding principles" which have great importance: (1) the requirement that the implementation of the CRADA shall advance program missions at the laboratory—internally pertinent and relevant—including any national security mission, and (2) the overriding concern for the safeguarding of classified and sensitive information. From these two enunciated guiding principles, particularly the former—which requires that the CRADA activity should be *relevant* to the mission of the

laboratory—will become an essential element in the discussion of evaluation criteria for CRADAs presented in Chapter V.

D. THE CRADA PROCESS

The following diagram represents the basic steps through which a CRADA evolves **(Figure 4)** as it is captured by the DoN standard CRADA process.

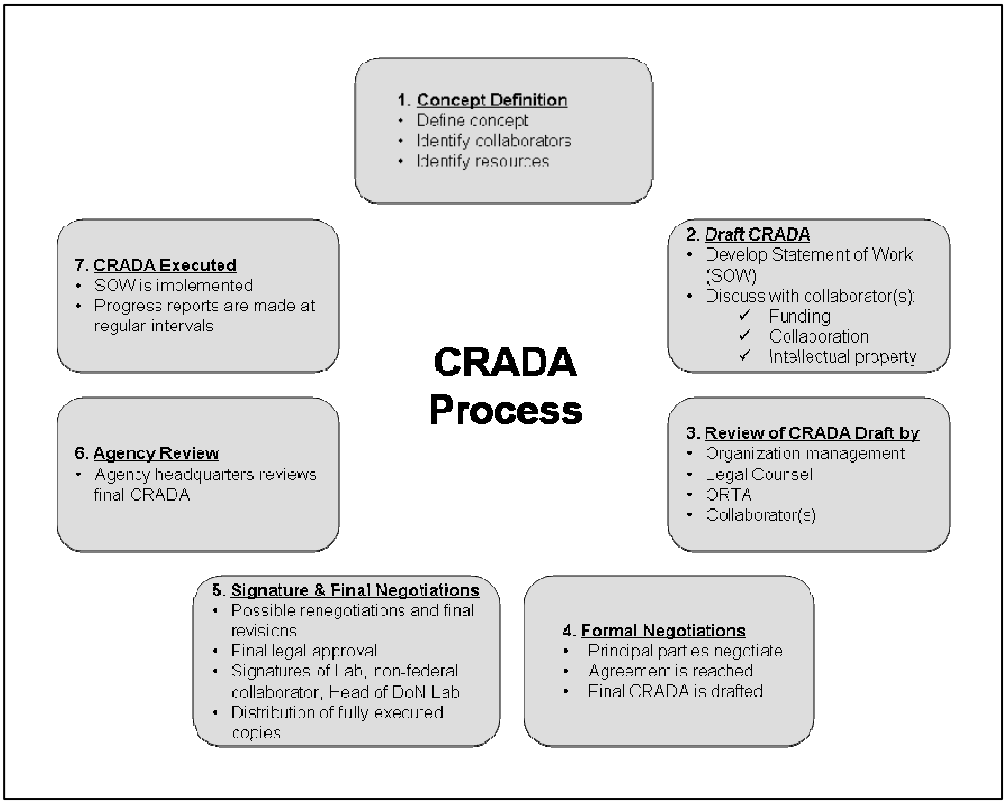

Figure 4: The DoN CRADA Process (ONR, 2005a).

The most important aspects of each step are summarized below (extracted from ONR, 2005a), adjusted for and commented in regards to the standard procedure at the Naval Postgraduate School Research and Sponsored Programs Office (RSPO):

1. Concept Definition

Principal Investigator (PI) (scientist/engineer/faculty):

- Develops initial concept jointly with industry counterpart for the agreement.
- Identifies necessary resources.
- Contacts RSPO—the NPS ORTA Representative—to request support and obtain a list of information requirements that need to be gathered from the industry partner to initiate the process.

RSPO:

- It is the primary negotiator between the non-federal partner and school personnel.
- In response to the request from the PI, it needs to obtain the following information (usually provided by the PI):
    - Title of project.
    - NPS PI (may be more than one, in which case one acts as the principal investigator and the other as Co-PI or Associate PI).
    - Industry partner data and point of contact (POC) information.
    - Scope of work (including general information regarding the "technical area" of the collaborative effort and on the expertise of the partners in the area of the collaborative effort).
    - Objective of work (specific objectives which are going to be accomplished).
    - Tasks that the NPS will perform.
    - Task that the industry partner will perform.
    - Task that will be performed jointly.

- Period of performance.
- Deliverables and milestones.
- Budget and funding information (if funding is to be provided by the non-federal partner).
- Security classification.

2. Draft

RSPO:

- Verifies with legal department CRADA appropriateness.
- Drafts key terms into initial CRADA document using the model CRADA as a reference. Particular considerations apply to classified agreements.
- Drafts preliminary statement of work (SOW).
- Initiates negotiations for the statement of work (SOW) between parties.
- Assigns NPS tracking number, creates files and enters CRADA into internal database.

3. Review of CRADA Draft

Principal Investigator (PI) (scientist/engineer/faculty):

- Reviews evolving versions of the draft SOW.

RSPO:

- Reviews complete CRADA draft.
- Submits to legal office to perform final legal review of the complete CRADA draft.
- Sends a copy of the draft CRADA to the industry partner for review.

4. Formal Negotiations

RSPO:

- Convenes negotiating team—PI, legal counsel (on both sides of the agreement), RSPO staff (and the equivalent staff on the other side of the agreement too), school, department and/or institute leadership and expert technical personnel as necessary.
- Conducts all follow-on negotiations with the industry partner on behalf of the School.
- Prepares final draft of CRADA.

5. Final Negotiations and Signature

RSPO:

- Submits final version of CRADA to partner for signature.
- Obtains NPS President's signature.
- Forwards copies of executed CRADA to:
  - NPS legal office.
  - Industry partner.
  - Principal Investigator.

6. Agency Review (ONR on behalf of the Department of the Navy)

- An additional copy (hard copy and electronic form) is submitted to ONR, together with a Summary Page document.
- ONR has 30 days to review, approve, reject, or modify.
- RSPO enters CRADA into Defense Technology Transfer Information System (DTTIS) database.

7. CRADA Execution

- NPS and industry partner perform tasks as determined in the SOW.
- PI provides periodic interim progress reports to RSPO.
- RSPO submits interim reports to industry partner.
- During the execution of the CRADA, further negotiations between the parties may indicate the convenience of extending the duration of the agreement which can be done through an amendment. Amendments are also used to add new tasking to an existing CRADA through additional statements of work (SOW).
- Deal according to specific procedures with intellectual property issues arising from the execution of the CRADA. For example, confer and consult with industry partner on patent applications resulting from joint inventions and review proposed abstracts, publications, presentations or other documents resulting from the work being performed under the CRADA for analysis of disclosure of proprietary information.
- Deal according to specific procedures with abnormal termination of CRADAs (e.g., funding defaults).

8. CRADA Termination and Closure

Although it is not in the original ONR diagram presented above, it would very important to explicitly add this significant missing step. There are general and specific requirements that need to be satisfied when the CRADA comes to an end.

- Return excess funds.
- Issue financial report to industry partner.
- Submit a final report to industry partner that contains results obtained and a list of all subject inventions.

It is very interesting to note that the ONR "CRADA Online Course for the Office of Research and Technology Applications (ORTA)" indicates that *"average time for this*

process is 6 weeks" (ONR, 2005a), counting from *Concept* to the start of implementation of the fully executed CRADA.

E. THE "MODEL" CRADA

Each federal agency is allowed the liberty to develop and distribute to its organic laboratories (and also for non-federal entities which operate GOCO laboratories under contract with a federal agency) its own CRADA model. In this regard 15 U.S.C. 3710a also provides the following guidance:

> [Each agency] shall develop and provide to such laboratory or laboratories one or more model cooperative research and development agreements, for the purposes of standardizing practices and procedures, resolving common legal issues, and enabling review of cooperative research and development agreements to be carried out in a routine and prompt manner (FLC, 2002, p. 30).

The FLC *Technology Transfer Desk Reference* provides a useful annotated generic model CRADA as a reference. The Department of the Navy has developed and evolved a similar model Navy Standard CRADA (now in its 5th Edition, Revision 1 - 1 May 2002). This model, which is attached as Appendix D at the end of this thesis, will be briefly analyzed in the next section.

F. PARTICULAR CONSIDERATIONS IN THE DOD/DON ENVIRONMENT

1. Department of Defense

Section 6.17 of the DoD Instruction (DoDI) 5535.8 (May 14, 1999) "DoD Technology Transfer (T2) Program", Guidance and factors to consider when using a CRADA (DOD, 1999a, pp. 13-15), provides specific guidance concerning CRADAs, aligned with Federal policy. In addition to the "standard" definitions (including the "Technical Assistance" CRADA) there is an additional type of CRADA which is peculiar to the DoD environment, the "Military-Use CRADA", which is:

> A CRADA between a DoD laboratory and/or technical activity and an industrial partner to utilize existing unique capabilities and facilities at the DoD laboratory in a product or process intended primarily for DoD or

> other military use. Each participant recognizes that it cannot support the research alone nor duplicate existing research or facilities. The technology is incorporated in new DoD systems or products as well as in other commercial opportunities (DOD, 1999a, p 18).

In a "Technical Assistance" CRADA (which is not exclusive to the domain of the Department of Defense) the federal laboratory or technical activity and a non-federal partner are allowed to work jointly to provide technical assistance and consulting to a local business (the requester company) for a period not to exceed four days. For this purpose, a short two-page "mini-CRADA" agreement is written and signed.

Finally, although other technology transfer mechanisms and combinations of activities are defined and encouraged, CRADAs and their bidirectional nature are certainly given specific preference for R&D activities:

> Cooperative Research and Development Agreements—CRADAs—should be used whenever possible to expand capabilities for R&D and to transfer technology developed jointly or independently to enhance both defense capabilities and the civilian economy (DOD, 1999a, p.4).

2. Department of the Navy

In the Secretary of the Navy Instruction (SECNAVINST) 5700.16A (March 7, 2000) "Domestic Technology Transfer (T2)" the Chief of Naval Research (CNR) is given *oversight* authority for execution of all DoN technology transfer matters, specifically including the institution of "policies under which laboratories and/or technical activities may be authorized to enter into CRADAs" (DON, 2000, p. 2) and other T2 programs. Similarly, all DoN laboratories and/or technical activities are delegated the authority to enter into CRADAs, including technical assistance and military-use CRADAs, provided that a set of specific procedural, organizational and formal qualification and conditions are met (DON, 2000, p. 3) (see also Appendix C).

The Navy definition of a CRADA is in line with previously seen definitions, but—properly—it also adds the mandate that the R&D effort encompassed by the CRADA must be in an area consistent with the laboratory's mission.

> Navy Cooperative Research and Development Agreements (CRADAs) are legal agreements between a Department of the Navy R&D laboratory an a non-Navy partner to conduct joint research and development efforts in a given technical area consistent with the laboratory's mission and to share in the technical results derived from the join effort (ONR, 2005a).

The *bidirectional* nature of the agreement is also implied in the previous definition. The specific mention to the *joint* nature of the R&D efforts and the notion of *sharing* in the technical results derived clearly indicate that—in addition to the benefits realized by the non-federal partner—the Navy also expects to obtain benefits from the CRADA.

Operational Documents and Guidance

As previously mentioned, across the Navy, a standard CRADA format is used for most agreements. This "Model" CRADA (see Appendix D), together with a comprehensive document on "Instructions for Use" (ONR, 2002b), was developed by the Office of Naval Research (ONR) under the authority granted by the previously mentioned directives and instructions. Additionally, the ONR developed the "Navy Standard Cooperative Research and Development Agreement Handbook", also known as the *Navy CRADA Handbook* (ONR, 2002a) which is the one-stop reference for the complete CRADA process and related documents within DoN organizations.

The model Navy Standard CRADA is very similar to the FLC Model CRADA (FLC, 2004, pp. C-1 to C-22) and only some minor differences exist, mostly with additional provisions and wording for intellectual property issues. Also, the Navy Standard CRADA includes particular information requirements for classified agreements (DD Form 254).

The following table **(Table 3)** shows a mapping of content and articles between the FLC "Model" CRADA and the Navy "Standard" CRADA.

FLC Model CRADA		U.S. Navy Standard CRADA	
Art. 1	**Definitions**	Art. 1	**Definitions**
Art. 2	**Cooperative Research**	Art(s). 2 and 3	**Objectives (2)** **Responsibilities (3)**
Art. 3	**Reports**	Art. 6	**Reports and Publications**
Art. 4	**Financial Obligations**	Art. 5	**Funding**
Art. 5	**Title to Property**	Art(s). 7 and 8	**Intellectual Property (7)** **Tangible Property (8)**
Art. 6	**Inventions and Patents**	Art. 7	**Intellectual Property**
Art. 7	**Data and Publications**	Art(s). 6 and 7	**Reports and Publications (6)** **Intellectual Property (7)**
Art. 8	**Representations and Warranties**	Art. 4	**Representations and Warranties**
Art. 9	**Termination**	Art. 10	**General Provisions - Termination**
Art. 10	**Disputes**	Art. 10	**General Provisions - Disputes**
Art. 11	**Liability**	Art. 9	**Liability**
Art. 12	**Miscellaneous**	Art. 10	**General Provisions**
Art. 13	**Duration of Agreement and Effective Date**	Art(s). 11 and 13	**Modifications and Notices (11)** **Duration (13)**
App. A	**Statement of Work**	App. A	**Statement of Work**
App. B	**Estimate of Parties' Resources**	App. A	**Statement of Work**
		Art. 12	**Surviving Provisions**
		Art. 14	**Signatures**
		App. B	**Confirmatory License Agreement**

Table 3: Mapping of Content from the FLC "Model" CRADA to the Navy "Standard" CRADA

G. BENEFITS RESULTING FROM CRADAS

CRADAs provide very significant benefits to all parties involved in the agreement. In the findings of a very interesting study conducted for the Office of the Director, Defense Research and Engineering – Office of Technology Transition by the

consulting firm Booz, Allen & Hamilton, the team concluded that these benefits include (Booz, Allen and Hamilton, 1999, pp. 17-23):

- CRADAs are "mission extenders" for the federal laboratories, permitting joint government-commercial funding of important research areas, where the government alone could not have funded them fully by itself.

- CRADAs can provide a means for industry to talk openly with the government; proprietary information and intellectual property[6] are safeguarded by the CRADA mechanism.

- CRADAs are a means of advancing R&D to levels that would have taken longer to achieve independently for each partner. Even if objectives for the CRADA are not completely met, less money and time are spent going down wrong paths; specifically:

> Drawing upon external expertise can provide the means to overcome obstacles that can present themselves along the path to new discoveries or even determine that the path being pursued is leading to a dead-end, and another needs to be followed (Booz, Allen and Hamilton, 1999, p. 19).

- CRADAs can provide industry access to government/military facilities (particularly test sites) which are not otherwise available to the private sector. The reimbursements generated by this activity can offset the costs of maintaining these critical facilities and expertise.

- CRADAs can result in new, improved or more cost-effective products, processes and services, which in turn can provide DoD with more affordable procurements to satisfy its own mission needs.

- CRADAs can advance research to superior levels in the R&D cycle or generate ideas which can lead to new R&D programs and opportunities altogether.

- CRADAs eliminate most of the interpersonal barriers that normally arise in other contractual agreements. The establishment of an environment of mutual *trust* [7] is both a prerequisite and a persistent condition for sustained collaborative work over time.

6 *Intellectual property* issues are a fundamental theme in any discussion about technology transfer. A detailed analysis is presented in Chapter VII.

- Finally there is the financial benefit side of the CRADA. While the federal partner alone can obtain direct cash funding from the non-federal partner in a CRADA, another important financial benefit is achieved by both partners from the cost savings accrued as a result of leveraging personnel, facilities, equipment and property belonging to the other partner. This concept is referred to as *cost avoidance* and although not usually well documented, it could amount to a *substantial* portion of the total R&D effort incurred in the project and is, therefore, an important consideration when assessing a potential CRADA (Grooves, 2000). Cost avoidance is defined as:

> The additional cost in labor, facilities, equipment, and property that a partner would have experienced in achieving the desired technology development, had the cooperative development partnership not been in place (Grooves, 2000, p.1).

Summarizing, the collaborative nature of the CRADA environment provides a clear "win-win" situation to all parties involved. Almost all studies regarding CRADAs in one way or another reflect this same basic notion: that by pooling resources through the CRADA, all participating parties can leverage scarce R&D funds, resulting in higher order research efforts that either party could have achieved alone.

As it will be seen later in Chapter VI (Analysis and Assessment of Selected CRADAs at the Naval Postgraduate School) *all* of the previously mentioned potential benefits from CRADAs have been to some great extent realized through the School's CRADA program. These and some others that are specific to the *dual* research-academic environment that characterizes the NPS will be presented in more detail in Chapter VI.

7 *Trust* is also a central theme in technology transfer, particularly in collaborative endeavors. An in-depth discussion about this is also presented in Chapter VII.

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IV. TECHNOLOGY TRANSFER AT THE NAVAL POSTGRADUATE SCHOOL

A. BACKGROUND

The Naval Postgraduate School (NPS) was founded at the U.S. Naval Academy (Annapolis, Maryland) in 1909 to satisfy the requirement for a "focused Engineering Program" (NPS, 2004b, p.ix) for the Fleet[8]. In its almost one-hundred years of existence the NPS has graduated more than 45,000 students from the U.S. and more than 70 other countries (NPS, 2004b).

NPS is an accredited university that holds the status of a *Specialized Institution* according to the Carnegie Classification of Institutions of Higher Education (Carnegie Foundation, 2000). It offers graduate education (master degree programs in 42 disciplines, doctoral degrees in 10 disciplines, 2 engineering programs, and a post-doctoral program). In addition to that, the School reaches out to numerous off-campus locations all over the U.S. and abroad to more than 300 students per year through a very extensive distance learning program (NPS, 2004b).

The mission of the NPS is to "provide relevant and unique advanced education and research programs in order to increase the combat effectiveness of U.S. and Allied armed forces and enhance the security of the United States" (NPS, 2004a, p. 4). The School fulfills its mission by providing a unique military-relevant graduate education program that meets the highest academic standards, while at the same time responding to the rapidly changing educational and research needs of the Department of Defense (DoD), other Federal Agencies and laboratories, and international allies.

NPS is comprised of four graduate schools, a Center for Executive Education, and several research centers and institutes:

8 Initially, courses were taught in marine engineering, ordnance and gunnery, electrical engineering, radio telegraphy, naval construction, and civil engineering. A brief review of the history and heritage of the NPS is presented in http://www.nps.edu/Aboutnps/Navigation/Heritage.html

1. Academic Schools

- Graduate School of Business and Public Policy (GSBPP)
- Graduate School of Engineering and Applied Sciences (GSEAS)
- Graduate School of Operations and Information Sciences (GSOIS)
- School of International Graduate Studies (SIGS)

2. Institutes

- Modeling and Virtual Environments and Simulation Institute (MOVES)
- Wayne E. Meyer Institute of Systems Engineering
- Cebrowski Institute for Information Innovation and Superiority
- Defense Resources Management Institute (DRMI)

3. Research Centers[9]

- Center for Interdisciplinary Remotely Piloted Aircraft Studies (CIRPAS)
- Center for Information Systems Security Studies and Research (CISR)
- Center for Autonomous Underwater Vehicle Research
- Center for Joint Services Electronic Warfare Simulation and Modeling
- Center for the Study of Mobile Devices and Communications
- Center for Material Sciences and Engineering
- Center for MASINT Research
- Software Engineering Automation Center (SEAC)
- Cryptologic Research Center
- Aerodynamic Decelerator Systems Center
- Navy/NASA Joint Institute of Aerospace Sciences
- Research Center for Military Applications of Space
- Spacecraft Research and Design Center
- Turbo-Propulsion Laboratory

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9 A Research Center is a group of faculty/staff with a significant concentration of expertise in a particular area, normally with an emphasis on applications.

- Vertical Flight Technology Center
- Center for Radiation Hardened Effects
- Undersea Warfare Center
- Center for Reconnaissance Research
- Center for Civilian-Military Relations (CCMR)
- Center for Homeland Defense and Security (CHD/S)
- Center for Contemporary Conflict (CCC)
- Center on Terrorism and Irregular Warfare
- Center for The Study of Potential Outcome
- Center for Recruiting Innovation

Research is an essential activity at NPS, not only to support the graduate education of the student body but also to satisfy critical, mission-relevant requirements of the Department of the Navy (DoN), other Services, and Federal Agencies which participate in the School's strong sponsored programs.

The sponsored research program at NPS (NPS, 2003):

- Maintains upper division course content and programs at the cutting edge.
- Challenges students to creatively solve DoD relevant issues.
- Advances Department of Navy (DoN)/Department of Defense (DoD) technology warfare problems.
- Attracts and retains quality faculty.

It comprises:

- Basic and applied research.
- Individual and group projects.
- Fleet support.
- Cooperative Research and Development Agreements with industry.
- Cooperative research with universities and Government laboratories.

As part of its mission and in response to legislation passed to encourage the transfer of federally funded technology to the private sector the NPS has also developed over the years a strong and very active *Technology Transfer Program*.

What follows is a compilation of information pertaining to the NPS Technology Transfer Program which has been extracted and condensed from different official publications and documents, specifically the NPS *Technology Transfer Business Plan* (NPS, 2003), the NPS *Research Newsletter*[10] and the NPS Research webpage[11]. Of particular interest are two additional documents: the School's Strategic Plan, *"A View to the Future: The Naval Postgraduate School"* (NPS, 2004a), and the NPS Foundation *Transformation Center Business Plan* (NPSFI, 2004).

B. ORGANIZATIONS

The Associate Provost and Dean of Research has direct responsibility for the NPS *Technology Transfer Program*. The Office of the Associate Provost and Dean of Research provides managerial and administrative support for the Technology Transfer Program and is instrumental as a liaison with entities outside of NPS for raising the awareness of the wide range of opportunities offered by the School's research program. Other organizations which provide additional support to the NPS Technology Transfer Program include:

1. Research and Sponsored Programs Office (RSPO)

The RSPO is a centralized administrative unit reporting to the Associate Provost and Dean of Research. The RSPO provides support to the NPS' sponsored research and education programs and the NPS Institutional Research Program; it is clearly the focal point and clearinghouse for all research-related activity at the School. Specifically the RSPO:

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[10] The NPS quarterly *Research* Newsletter is available (June 1998-Fbruary 2004) at http://www.nps.edu/Research/Publications/Newsletters.html.

[11] Available online at http://www.nps.edu/Research/index.html.

- Administers the NPS institutionally funded research program.
- Administers research and education sponsored programs.
- Administers student fellowship programs.
- Administers NPS agreements, chair professorships, post-doctoral programs, and research centers.
- Administers the NPS *Technology Transfer Program*.
- Coordinates contractual services for sponsored programs.
- Processes NPS theses.
- Publicizes NPS research.
- Maintains NPS Faculty Expertise Directory.

As the "administrator" of the T2 program, the RSPO acts as the Office of Research and Technology Applications (ORTA) representative, whose primary responsibility is to assist faculty and their industrial partners with the means for initiating cooperative agreements. The ORTA representative also identifies and markets existing NPS technologies.

2. NPS Research Board

The NPS Research Board is comprised of the Associate Chairs of Research from each of the academic departments and interdisciplinary groups, and its basic function is to provide expert technical support. One of the functions of the Board is to serve as the Invention Evaluation Board which reviews and prioritizes patent applications and considers renewal of maintenance fees for existing patents. The Board is also instrumental in advising the Associate Provost and Dean of Research on policies governing the overall NPS Research Program.

3. Office of General Counsel Representative (OGC)

The OGC representative at the Naval Postgraduate School provides legal support, reviews all Cooperative Research and Development Agreements (CRADAs), Memoranda of Understanding (MOU) and Agreement (MOA), and facilitates the patent application process.

4. NPS Foundation Transformation Center (TC)

The TC was established in response to the need to more rapidly and effectively move research and development to the warfighter and other national security organizations, to support the mission of NPS. Although the TC is a new organization (2004), its parent organization, the NPS Foundation, is a long-established, non-profit organization within the NPS whose purpose is to support NPS—through a myriad programs and sponsored activities—in areas related to national defense.

Among the TC *key* stated objectives, some which are particularly relevant to the T2 domain include (NPSFI, 2004, p.1):

- Strengthen and facilitate rapid transformation capabilities between government researchers and their counterparts in the private sector.
- Implement Congressional and DoD guidance to improve outreach programs for technology transfer to corporate America, small businesses, state agencies and academic institutions.
- Work closely with the NPS Dean of Research and Directors of NPS Research Institutes to strengthen and expand relationships of these Institutes with the corporate world.

C. RESOURCES

NPS possesses vast resources to support the Technology Transfer Program. Unique laboratory facilities (mostly part of the research centers mentioned above) and a diverse faculty with expertise covering a broad range of technical areas are the *core assets* for initiating and sustaining the T2 Program. Classified facilities allow research up

to the Sensitive Compartmented Information (SCI) level. In addition to the highly qualified and recognized civilian faculty, the presence of *military* faculty and students with a broad spectrum of operational expertise and real-world current experience adds a unique capability to the research conducted at the School.

Small Business Innovation Research (SBIR) Site

NPS has recently become an SBIR site. As such, NPS faculty can identify potential SBIR topics and monitor the progress of those programs which have been awarded. The SBIR Program is another approach for increased interaction with industry and increases industry's awareness of NPS research opportunities. NPS also participates in the Small Business Technology Transfer (STTR) Programs.

D. THE NPS TECHNLOGY TRANSFER PROGRAM (TTP)

In addition to the aforementioned SBIR and STTR programs, the School employs some other primary mechanisms for T2:

1. Cooperative Research and Development Agreements (CRADAs)

CRADAs are the most important mechanism used to engage in cooperative R&D activities with private companies, universities, state and local agencies, and non-profit organizations. CRADAs can also be used to support certain phases of SBIRs.

2. Patents

Patents and licensing agreements facilitate the transfer of federally funded research to the private sector. NPS faculty and students routinely file patent applications when their research reaches a stage which warrants the protection provided by this mechanism. Since 1990, over 35 U.S. patents have been awarded in connection to NPS conducted research.

3. Publications

Publication is one of the most basic mechanisms for technology transfer. NPS faculty and students publish extensively in refereed journals and other scholarly publications. As part of their masters' degree, NPS students are also required to complete a thesis. Abstracts of NPS student theses are available on the World Wide Web[12] and full-text versions through the Defense Technical Information Center (DTIC)'s Scientific and Technical Information Network (STINET).

4. Memoranda of Understanding (MOU) and Memoranda of Agreement (MOA)

These agreements are used with other DoD or Federal entities and they can be applied to provide additional T2 links—through the partnering agencies—with entities outside DoD.

5. Consortia

NPS actively pursues partnerships with other academic and professional institutions through consortia. Some of these consortia are organized within a regional context, for instance the Monterey Bay Crescent Ocean Research Consortium, which is a confederation of several agencies (education, research, governmental, advocacy) around the Monterey Bay, which is focused on the ocean sciences.

NPS is also leading the organization of the World Wide Consortium for the Grid (W2COG) which is an open consortium—in startup mode since October, 2004—comprising government, industry and academic members chartered with the goal of advancing networking technologies and policies to support Network Centric Operations.

6. Work for Others[13]

While this activity does not itself constitute a mechanism of technology transfer, it allows the private party to learn more about NPS capabilities and opportunities which

[12] Available online at http://www.nps.edu/Research/MoreThesisAbst.html.

[13] Sometimes also referred to as Work-for-Services.

could possibly lead to a follow-on T2 relationship, for example a CRADA. A Work-for-Others agreement is used when a federal laboratory can provide an existing product, material or service to a private party, without competing with the private sector. The laboratory is not interested in the research outcome (ONR, 2003).

E. TECHNOLOGY TRANSFER PROGRAM (TTP) OBJECTIVES

The NPS *Technology Transfer Business Plan* (NPS, 2003) states that the primary objectives of the School's T2 program are:

- To initiate partnerships with industry and/or academia;
- To license existing technologies; and
- To encourage and assist faculty and staff to transfer newly developed technologies to the private sector.

A true *cornerstone* policy and guidance document which contains a significantly expanded enunciation of strategic objectives for the School is the NPS Strategic Plan: *"A View to the Future: The Naval Postgraduate School"* (NPS, 2004a).

This document states that the NPS vision is to "be the world leader in naval and defense related graduate education and supporting research, and prepare the intellectual leaders of tomorrow's forces" (NPS, 2004a, p. 4). To support this vision, the NPS has identified four *strategic initiatives*:

- Strategic Initiative # 1 (STI1): ***"Increase the number of Navy unrestricted line officers with graduate education."***
- Strategic Initiative # 2 (STI2): ***"Improve the quality and applicability of our teaching and research."***
- Strategic Initiative # 3 (STI3): ***"Increase the number of meaningful partnerships and available markets for our services."***
- Strategic Initiative # 4 (STI4): ***"Cut the right costs; invest resources in the right things."***

From this list, STI2 and STI3 have clearly *essential* implications for the School's research program in general and the technology transfer sub-domain in particular. STI2 states that:

> The success of any university depends largely on the quality of its research and teaching programs and its faculty … High quality teaching requires a first-rate research program. Research helps keep faculty at the forefront of their discipline, thereby assuring that our students will be taught the most up-to-date material. Research assures that the latest processes, materials and technologies can be transferred to the Navy and Marine Corps to help strengthen the nation's defense. Finally, research contributes significantly to NPS' national and international prominence, thereby increasing the value of our degrees to our graduates (NPS, 2004a, p. 7).

STI3 adds the following concepts:

> The Naval Postgraduate School prides itself on the strength and depth of our collaborative relationships with others. We are especially proud of our partnerships with other colleges and universities, business and industry, government, and the international community … To sustain its role as a leading center for research and technological developments, NPS must continue to build its programs in interdisciplinary areas. Collaboration within NPS is absolutely necessary. At the same time, NPS must look beyond itself and nurture collaboration with other colleges and universities. This can be done in a number of ways including joint research program and faculty and student exchange programs … This expansion and development will enhance the education of our students and assure that our faculty will remain competitive in research and teaching (NPS, 2004a, p. 7).

In the following chapter we will articulate how these objectives and strategic initiatives provide the foundation upon which the "value-added" by collaborative technology transfer programs—CRADAs in particular—can be assessed and measured.

F. CRADAS AT NPS

CRADAs are an essential component of the School's Technology Transfer Program. In the thirteen years that have passed since the first NPS CRADA with General Electric Government Services (GEGS) entitled: "Thermoacoustic Life Sciences

Refrigerator" was signed on June 10, 1992, more than 70 CRADAs have been entered into by the School with many non-federal partners, from a wide range of sectors and disciplines. More than 25 additional CRADAs are at this writing at some stage of the development or negotiation phases.

The growth in the number of agreements has been significant in the last few years. **Figure** 5 shows the evolution of the number of CRADAs entered by the School since 1991. Only fully-executed CRADAs are counted and the year indicates when the agreement was initiated (not necessarily the same as the effective date). Because of that, the figures for 2004 and 2005 will more likely double when the different in-process CRADAs are finally signed and entered.

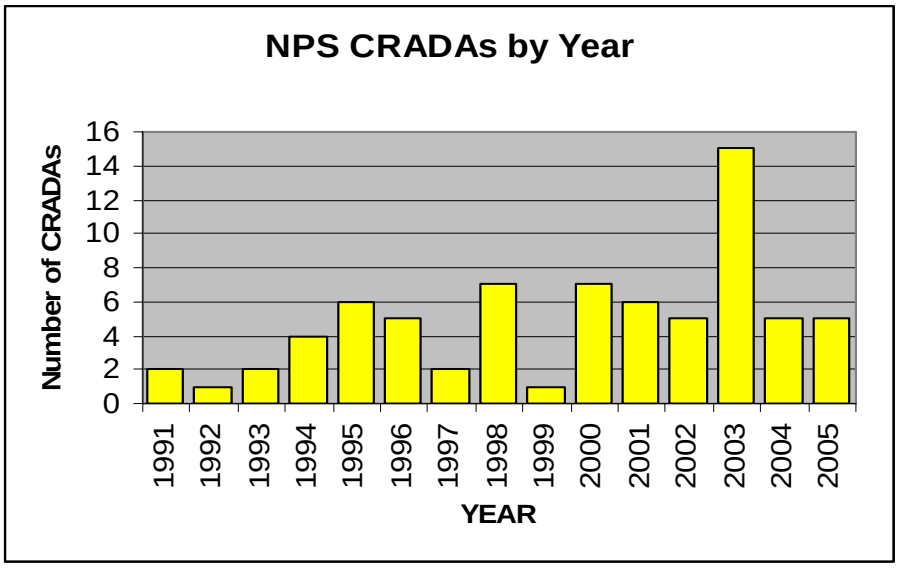

Figure 5: Number of CRADAs entered into by NPS (year indicates starting of process).

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V. DEVELOPMENT OF EVALUATION CRITERIA AND METRICS

A. INTRODUCTION

Technology transfer effectiveness is a very difficult *thing* to measure. Perhaps, one of the principal obstacles encountered when trying to find suitable criteria to assess the "value" of technology transfer programs resides in the inherent difficulty in defining "technology transfer" itself. As we have seen in Chapter II this has proven to be a very elusive concept, even in highly specialized and competent circles. *Context* is critical and there seems to be as many definitions of "technology transfer" as there are different domains of application.

There is a great abundance of literature that highlights the fact that T2 effectiveness, or value—or even impacts—are very hard to measure. Some of these studies are particularly focused on *collaborative* efforts and hence their findings are directly applicable to our domain; some others have a sufficiently broad scope that the conclusions can be applied to *any* T2 endeavor and their findings can be generalized without compromising the validity of the judgments made.

As expected, the points of view presented in most of the aforementioned studies vary considerably; however, there is reduced set of facts about collaborative T2 evaluation criteria and metrics which are almost *universally* accepted:

- Gibson et al. (1996) refer unequivocally to the first *golden* rule: "there is an increased realization that volume alone is not an adequate measure and may even be a counter productive measure of the effectiveness and impact of CRADA programs" (Gibson et at., 1996, p. 232). And this is true even when the resulting numbers have been *normalized* to try to remove the "size" factor from the variable; for instance, dividing the number of agreements per million dollars of total R&D expenditure or per faculty member.

- Siegel et al. (2000) refine the previous statement a little further; they express that the "agreements vary substantially in their significance, making it dangerous

to draw inferences about aggregate technology flows based on the number of deals" (Siegel et al., 2000, p. 17) alone.

- Many studies have been significantly successful in correlating *tangible* outcomes from collaborative agreements with thriving T2 programs. In most of these cases program "effectiveness" is captured by complex indices, the majority of which are somehow related to the commercial application[14] of the technology transferred. On the other hand, it is inevitable to point out that many professionals and practitioners in the collaborative T2 domain also indicate the existence of *intangible* outcomes, which sometimes have a bigger, more strategic and long-lasting impact on the final *value* obtained from the agreements.

- An excellent example of the previous line of thought is contained in the Booz, Allen & Hamilton (1999) study prepared for the Office of the Director, Defense Research and Engineering *"DoD Cooperative R&D Agreements: Value Added to the Mission"*. This study looks at the contributions made by the CRADA to the laboratories' specific missions as a means of showing how they generate value back to DoD. Interestingly, the study concludes that "there is a belief that CRADAs should lead to commercial products in order to be considered 'successful.' However, in actuality this appears to be the exception rather than the rule" (Booz, Allen and Hamilton, 1999, p. 17)

- Lastly, another critical issue that has been pointed out in some studies is that the evaluation criteria used to capture the *intangible* outcomes are usually based on "perceptions", and hence, cannot be measured objectively[15]. For instance, Rogers et al. (2000), referring to laboratory director's furnished data used in some of the analyses, question "the validity of such measures, based on the perceptions of individuals who might have a vested interest in presenting a favorable picture of their organization's accomplishments" (Rogers et al., 2000, p. 7).

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14 For example, Rogers et al. (2000) present a composite measure of technology transfer effectiveness in U.S. research universities which computes a complex index based on six selected indicators of T2: (1) the number of invention disclosures received, (2) the number of U.S. patents filed, (3) the number of licenses/options executed, (4) the number of licenses/options yielding revenue, (5) the number of start-up companies formed, and (6) the gross revenue generated by licensing university-owned technologies to commercial companies.

15 Due to the likelihood of encountering *biased* responses.

Summarizing, simplistic metrics like *volume* (number of agreements) without further qualification are unacceptable as a valid measure of effectiveness; *intangible* benefits, although extremely important—particularly in collaborative agreements—are difficult to capture objectively; and *context* is essential. These are *guiding principles* that should be kept in mind when trying to find useful and appropriate evaluation criteria and metrics.

There is, however, a manifest benefit for CRADAs when compared to technology transfer programs in general. Since *context* is so critical, a more narrowly defined *context* will reduce the ambiguity present in certain criteria against which a T2 program can be assessed for "value". CRADAs are a particular *instantiation* of the broader concept of T2 and they occur in a very specific functional and organizational setting (collaborative and private-public); therefore, the context is sensibly reduced. Another advantage—in our case—is realized by the additional *context refinement* provided by the academic environment—at the NPS—that typifies the peculiar domain where CRADAs need to be evaluated.

For instance, whereas in other laboratories owned and operated by the Services[16], the impact of cooperative T2 programs on research "quality" alone could be used to define "success", in the particular institutional environment of the NPS this impact must also provide a *value component* in the academic dimension. Somehow the program should add value to the educational experience of the students; otherwise its effectiveness would be only partial and incomplete. This additional context refinement—truly resulting from an *intersection* of domains—reduces the "measurement space" and consequently makes the evaluation task even more focused.

Why—and When—Assess T2 Programs?

There are three occasions when one could—and should—assess a T2 activity or program: *a priori* and *a posteriori* immediately come to mind, but also *while* the activity or program is *ongoing*. To each one of these opportunities corresponds a totally different use of the information provided.

[16] Like the Naval Research Lab (NRL) and the Air Force Research Lab (AFRL).

For instance, the *a priori* assessment could be used to select one or more T2 activities that yield the best value from a portfolio of available opportunities, in a competitive and limited resource environment. The *a posteriori* assessment could be used to evaluate results (expected versus realized) and generate some type of learning from the experience—which should also provide useful criteria for future a priori assessments. A reward mechanism for excellent achievements—the basis for motivation and improvement—could also be fed by this a posteriori information. Finally, an assessment while the activity or program is *ongoing* could certainly provide useful information to manage and control the process, introducing effective correction mechanisms where and when they are needed.

Although some data for this particular research has been collected from "open" (ongoing) CRADAs, the intent was not to use the information produced for control or management purposes, but rather as an indication of *partial* accomplishment of CRADA objectives. Therefore, by design, the methodology used in this thesis results clearly in an *a posteriori* assessment.

B. PROPOSED EVALUATION CRITERIA

Following the previous discussion, we need to find a suitable set of evaluation criteria which simultaneously satisfy the three established *guiding principles*. Basically, we need to be able to:

- Avoid *simplistic metrics* (like number of agreements or the revenue generated) without further qualification.

- Clearly define our specific *context* and reference all evaluation criteria and metrics for program effectiveness to that context. This context includes the *direction* of the transfer.

- Capture *intangible* benefits as objectively as possible (avoiding, minimizing—or even accounting for—bias in the elicitation and analysis of responses).

Effectiveness Evaluation Criteria

Bozeman (2000) introduced the "Contingency Effectiveness Model of Technology Transfer" which provides a good approximation to the desired standard, although for a different and broader context[17]—universities and government laboratories, with a pronounced market oriented direction. The basic assumptions of this model are:

- Technology transfer effectiveness is multidimensional (market impact, political impact, impacts on personnel involved, etc.).
- The assessment is heavily dependent on the organizational context considered (i.e. universities, laboratories, etc.).
- No single notion of effectiveness "makes much sense, either theoretically of practically".

The following table (**Table 4**) presents briefly Bozeman's T2 effectiveness evaluation criteria:

Effectiveness Evaluation Criterion	Key Question
"Out-the-Door"	Was technology transferred?
Market Impact	Did the transferred technology have an impact on the firm's sales or profitability?
Economic Development	Did technology transfer efforts lead to regional economic development?
Political	Did the technology agent or recipient benefit politically from participation in technology transfer?
Opportunity Cost	What was the impact of technology transfer on alternative use of resources?
Scientific and Technical Human Capital	Did the technology transfer activity lead to an increment in capacity to perform and use research?

Table 4: Bozeman's Effectiveness Evaluation Criteria and Key Questions

[17] Not specifically focused on collaborative T2 programs.

Using Bozeman's approach, we introduce here a similar set of effectiveness evaluation criteria (**Table 6**), tailored to our particular T2 mechanism: cooperative R&D agreements, our focused direction: from the non-Federal to the Federal partner, and our specific organizational context: the academic/research environment[18].

Tailoring Bozeman's original effectiveness evaluation criteria entails adapting them through a *context transformation*. In some instances the original criterion is retained whereas in others one or more new criteria replace the old one for a better fit. This mapping can be seen in the following table (**Table** 5).

Bozeman's Effectiveness Evaluation Criterion	**Proposed Effectiveness Evaluation Criterion**
"Out-the-Door"	Not used. Assumed to be less relevant in the given T2 environment.
Market Impact	In this case, "market" impact (sales and profitability) is converted to an *analogous* impact in the specific domains considered: *Research Impact* *Academic Impact* *Curricular Impact*
Economic Development	Not used. Assumed to be less relevant in the given T2 environment.
Political	*Political-Strategic Impact*
Opportunity Cost	Not used. Assumed to be less relevant in the given T2 environment.
Scientific and Technical Human Capital	*Scientific and Technical Capability*

Table 5: Transformation of Bozeman's Criteria to the Proposed set of Criteria.

[18] With the particular "flavor" that characterizes the NPS as a unique *defense-oriented* academic/research institution.

The resulting set of criteria is presented in the following table (**Table 6**). Just like in the previous case, the *key questions* succinctly provide a broad perspective of the type of information captured by each criterion. We will later see how these criteria are supported by very specific rationale.

Effectiveness Evaluation Criterion	Key Question
Scientific and Technical Capability	Did the CRADA lead to an increment in scientific and technical capabilities relevant to the NPS mission?
Research Quality	Did the CRADA allow the attainment of higher order objectives in research programs and activities?
Academic Impact	Did the CRADA have a specific impact on the educational experience of students?
Curricular Impact	Did the CRADA have an impact on the curricular design at the NPS?
Political-Strategic	Did the NPS benefit politically from participation in the CRADA?

Table 6: Proposed Effectiveness Evaluation Criteria and Key Questions for the NPS academic/research environment.

For each of these effectiveness evaluation criteria, it is very useful to derive a rationale (see **Table 7**) that supports and further refines their meaning. The associated information requirements—information which needs to be collected and/or developed from lower-order, more basic data—for each criterion are specified in the METRICS section.

Effectiveness Evaluation Criterion	Rationale
Scientific and Technical (S&T) Capability	The key concept here is an assessment of : • The contribution of the CRADA program to an increment in S&T capabilities at NPS. • The relevance of those capabilities to the NPS mission (DoD/Navy impact).
Research Quality	The assessment is based on: • Concrete benefits to the research program (content, state-of-the-art, enabling technologies, and timing). • Miscellaneous support (funding, manpower, etc.).
Academic Impact	The assessment is based on: Student-specific research, experiences and activities: • Theses. • Course projects. • Exchanges. • Other (access to cutting-edge technology, practical application of theoretical knowledge, industry real-world interaction, participation in conferences and symposia, etc.).
Curricular Impact	The assessment is based on CRADA program as it relates to: • Enhancements to existing curricula and/or programs. • Creation of new curricula and/or programs.
Political-Strategic	The assessment is based on the program's contribution to: • Increase visibility and name recognition of NPS in the defense, academic and corporate environments (domestic and international). • An advantage in positioning NPS among peer-competing DoD institutions (competitive assignment of limited resources).

Table 7: Rationale for Proposed Effectiveness Evaluation Criteria.

C. SUPPORT FOR THE PROPOSED EVALUATION CRITERIA

It is possible to demonstrate that the proposed evaluation criteria can be traced back directly to higher order goals and objectives which are either explicitly or implicitly derived from the School's top-level policy and guidance documents seen in the previous chapter:

1. Scientific and Technical (S&T) Capability

NPS has been oftentimes called the "Navy Corporate University." Navy-corporate *collective* "knowledge capital" is increased when a new group of officers graduates from the different programs offered by NPS, anytime that the acquired knowledge is *relevant* to the Navy mission—the more relevant the knowledge, the higher the value.

Critical to this *relevance* issue is the relevance of the "knowledge capital" of NPS itself. This "knowledge capital" is inherently distributed and difficult to codify and store. It is mostly acquired through *capability building* over time. A large part of the "knowledge capital" of NPS resides in its faculty. Recruitment and retention of excellent faculty are absolutely critical[19]. The NPS *Strategic Plan* (NPS, 2004a) states that the "research agenda [need to] support the needs of the Navy and Defense while building the intellectual capital of our faculty" (NPS, 2004a, p. 3).

Although intuitively appealing, an empirical relationship between the CRADA program and faculty recruitment or retention rates would really be hard to establish—and even harder to sustain. On the other hand, a significant component of "value" for the CRADA program (as a contributor to the development or sustainment of NPS S&T *capabilities*) can easily be measured by assessing how relevant—for the Navy—are the technologies being developed and transferred using the CRADAs.

Knowledge relevance is proportional to mission relevance. Mission relevance (in fact, a legal requirement for CRADAs) in turn can be assessed by comparing the technologies being developed or advanced through CRADAs with high-level

[19] The student body has a high mobility associated with it, due to their relative short-term stay at the School—normally one or two years.

requirements documents like the Military Critical Technology List (MCTL), DoN Technology Needs or Future Naval Capabilities (FNC) supporting technologies.

2. Research Quality

The NPS *Strategic Plan* also states that "the success of any university depends largely on the quality of its research and teaching programs" (NPS, 2004a, p. 7). It further adds that a significant measure of the quality of the research program can be associated with its usage of the latest processes, materials and technologies.

CRADAs can be easily evaluated for their impact on the research program by assessing the specific *contributions* that are realized (enabled or enhanced) as a result of work performed as part of the agreements.

3. Academic Impact and Curricular Impact

The NPS *Technology Transfer Business Plan* states that:

> The research program exists to support the graduate education of our students. It does so by maintaining upper division course content and programs at the cutting edge; challenging students to creatively solve DoD relevant issues; advancing DoN/DoD technology; solving warfare problems; and attracting and retaining quality faculty (NPS, 2003, p. 2).

As part of their schooling, students at NPS are routinely required to participate in research activities that significantly enrich their educational experience. These activities are many and varied, ranging from "course projects" (with reduced scope and complexity) to more extensive "integrating" or "capstone" projects for some specific certifications and curricula. Additionally, as part of their degree requirements, students are expected to prepare and submit a thesis. The thesis is the culminating step in the application of the focused graduate education obtained by the students at NPS.

The research program in general and the CRADA program in particular can—and should—be effectively applied to generate new or enhanced research opportunities for students (course projects, theses, etc.).

On the other hand, partnerships with industry can also be effectively employed to implement new programs or enhance existing programs through innovative educational approaches and opportunities. Coleman and Shelnutt (1995), in "Fostering University-Industry Partnerships through Sponsored Undergraduate Design" provide a valuable assessment of industry sponsored capstone design projects and exchanges.

4. Political-Strategic

NPS does not exist in a vacuum. In a time of downsizing and rationalizing, shrinking budgets and drastic cost reductions, NPS—like any other public (particularly Defense) organization—must constantly validate its credentials in a competitive quest for survival. Essential to being the "world's largest and most prestigious defense-oriented graduate institution" is the need for NPS to be *perceived* as such among top-level decision makers who exercise influence, power and authority in the environment where NPS needs to prosper. The NPS Foundation *Transformation Center (TC) Business Plan* (NPSFI, 2004) captures this demand with accurate pragmatism: the School must increase its visibility and name recognition in DoD, corporate and academic circles.

Participation in high-visibility research programs (through collaborative agreements) with *world-class* industry partners from the Defense "corporate" community brings:

- Name recognition, with increased awareness of the unique capabilities of NPS.
- Competitive advantage for the allocation of resources in the DoD S&T environment.

C. METRICS

In order to support these proposed "effectiveness evaluation criteria" some specific metrics[20] need to be elaborated and supported. Proposed metrics are presented in

[20] A good definition of a *metric* in our context is provided by Kostoff (2005): "The dictionary definition of a metric is a 'standard of measurement'. In physical science, a metric is used to quantify physical and tangible items (mass, size, etc.). For science and technology evaluation, metrics have a different meaning and application. Metrics selected for S&T evaluation derive from the intrinsic unique features of S&T

Table 8. As we said before, unfortunately and except for a few exceptions there are no easily "quantifiable" variables which can readily provide an intuitive and logical connection between the proposed criteria and some countable item.

An important consideration that needs to be made is that not all effectiveness evaluation criteria are directly captured by a single metric or set of metrics. In that case, the specific information requirements are satisfied through the collection and analysis of other relevant information—not metrics—which are then used to guide the analysis and derive rational associations supporting the particular effectiveness evaluation criteria considered.

Lastly, since we are interested in CRADA *program* effectiveness rather than measuring effectiveness for an individual CRADA, an additional consideration is germane. Although the data—usually qualitative attributes—for our proposed set of metrics are obtained at the *individual* agreement level (for a single CRADA), the resulting metrics are presented for the *aggregate* program level. For instance, the number of CRADAs that have resulted in student theses, or the number of CRADAs that have generated curricular changes—in both cases as a percentage of the total number of CRADAs considered in the sample—are indicative of CRADA *program* effectiveness rather than for single CRADA evaluation.

Effectiveness Evaluation Criterion	Information Requirements	Metric
Scientific and Technical (S&T) Capability	- Relevant technologies analysis.	No particular metric will be defined/collected/created in this case. The information requirement to support the evaluation criteria will be obtained through the analysis and comparison of technologies transferred through the CRADA program against *objective* Navy "high-value"[21] technologies.

products and outputs, and can include economic, financial, and other research environmental and management metrics" (Kostoff, 2005, p. 18).

[21] As previously defined, these "high-value" technologies are those contained in high-level documents such as the Military Critical Technology List (MCTL), DoN Technology Needs or Future Naval Capabilities (FNC) supporting technologies.

Research Quality	- CRADA impact (quality/instrumental) on the research program. - CRADA impact (enabling) on the research program.	- Selection of quality attribute enhancements through specific "benefits" realized through the CRADA program. - Degree of attainment of research objectives. - Degree of "criticality" of the CRADA program on the attainment of those objectives.
Academic Impact	- CRADA generated student work (theses, projects, exchanges, etc.).	- Number of CRADAs that have resulted in: - Student theses - Course projects - Other activities.
Curricular Impact	- CRADA generated changes to curricula/programs.	- Number of CRADAs that have generated curricular changes, generated new programs or enhanced existing programs.
Political-Strategic	- Industry partner (significance) in the "corporate" defense community[22].	- As with the S&T Capability criterion, no particular metric will be defined/collected/created in this case. The information requirement to support the evaluation criteria will be obtained through the analysis and comparison of "political" relevance of CRADA program counterparts among peer organizations within the "corporate" defense community.

Table 8: Proposed Information Requirements and Metrics.

These effectiveness evaluation criteria and metrics will be used in the next chapter to drive the analysis and assessment of selected CRADAs at NPS.

[22] Interactions with other Federal laboratories and/or prestigious universities though CRADA related work (also through SBIR/STTR) are also *politically relevant*, but are beyond the scope of this research.

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VI. ANALYSIS AND ASSESSMENT OF SELECTED CRADAS AT THE NAVAL POSTGRADUATE SCHOOL

A. INTRODUCTION

The methodology used—after O'Keefe (1982)—was introduced in Chapter I. The methodology includes three major elements: (1) establishing specific evaluation criteria [and metrics], (2) gathering the necessary data, and (3) performing the consequential analysis to make judgments of value to support the goals of the evaluation effort. The first phase of that methodology, the establishment of specific evaluation criteria and metrics, against which *program* success (or lack thereof) is to be assessed, was presented in the previous chapter. The two subsequent phases, data collection and data analysis and report are presented in this chapter.

B. DATA COLLECTION

As described in Chapter I, three primary data collection methods were used: (1) document review, (2) in-depth direct interviews, and (3) self-report electronic questionnaires. Whereas the responses from the survey questionnaires will be presented separately, the outcome from the other two tasks (document review and direct interviews), due to its more informal and unstructured nature, will not be presented separately but rather in an integrated fashion in the ensuing analyses.

The *document review* task included the study and analysis of over 80 CRADAs from the existing RSPO archives and also the review of essential NPS policy documents related to technology transfer, introduced in Chapter IV. *In-depth interviews* were conducted with a sample of *key* stakeholders in the T2 process at the NPS, including faculty and leadership from academic departments and institutes, the Director and staff from the RSPO, and students. Industry current and prospective partners and a few important additional "actors" were also interviewed; for instance, the NPS legal counsel, the Executive Director of the NPS Foundation and—last, but not least—a particular faculty member whose professorship is part of a peculiar CRADA with an industry partner.

C. THE FACULTY SURVEY

The faculty survey questionnaire was administered to a group of Principal Investigators (PIs) from the selected CRADA sample, as identified in the document review task. The questionnaires (see Appendix A1) were administered in indirect-electronic form and included a combination of open-ended and structured questions designed to provide both qualitative and quantitative data to support the evaluation criteria and, ultimately, the research questions.

A similar questionnaire—tailored to the specific environment—was sent to industry counterparts for each CRADA, per contact information provided by the respective PIs (see Appendix A2).

1. Sample Selection

Once the "document review" task was completed, the full CRADA dataset sample was selected. A number of criteria were applied to determine which CRADAs should be chosen. To be accepted as valid and representative each selected CRADA had to satisfy all of the following restrictive criteria:

a. There are approximately 70 CRADAs officially entered into by the RSPO. Many more (close to 25, but the number can vary) are at different stages of development but not yet signed. From this set, the following CRADAs were immediately eliminated from the sample:

- All in-process CRADAs—still in the pipeline (not officially approved CRADA objectives, statement of work (SOW), duration, signatures, etc.).

- All CRADAs which have been closed for more than 5 years—in the assumption that PI self-reported information would not be "fresh" in their memories by now.

- All active CRADAs with less than 50% of progress-to-date—in the assumption that there has not been enough time for the necessary information to condense, particularly realization of benefits, fulfillment of objectives and student participation (somewhat an arbitrary cutoff).

- All CRADAs where the other partner is not "industry" (mostly academic institutions like California State University, Mississippi State University, George Washington University, Temasek Defense System Institute of Singapore, and a few other Federal, State and local organization like the Moss Landing Marine Laboratories and the New Jersey Department of Health and Senior Services[23]).

- Some of the older CRADAs for which documentation was not complete in the archives (some were missing the SOW, and in a few cases most of the original agreement had apparently been lost and only notes and records of exchanges between the partners remained).

- One particular CRADA where the PI could not be located in the faculty directory, who apparently left the School a few years ago.

b. After this selection process, a sample of 32 CRADAs remained for the PIs to be contacted, after which the electronic survey questionnaire was sent.

c. For this sample of 32 CRADAs, the following outcomes were obtained:

- 14 PIs responded (providing data for 19 CRADAs) [24].

- 1 PI did not want to answer the survey (due to concerns about proprietary information issues).

- 2 PIs stated that their CRADAs were cancelled before completion of any work.

- 8 PIs did not respond.

[23] The list is not exhaustive.

[24] The difference in the number of PIs and CRADAs is explained by the fact that some PIs have participation in more than one CRADA. Additionally, there is one “umbrella” CRADA that includes three different statements of work (SOW)—each with its own PI. The concept of an “umbrella” CRADAs is presented in Chapter VII. For the purpose of this research, these three different SOW (each with a different PIs) under the *same* CRADA were treated as if they were separate CRADAs.

2. Pilot Survey

Two separate survey questionnaires were sent. An initial small batch acted as a "pilot" designed to obtain an additional level of feedback—to make sure the recipients of the survey understood the questions and the electronic form fill-out procedure prior to submitting the questionnaire to the full set of PIs (sample)[25]. This small sub-sample included a number of faculty members who had been previously interviewed in person, or were PIs of a multiple-PI/multiple-task CRADA for which at least one PI had been previously interviewed. The "pilot" survey questionnaire was sent to three PIs; two responded.

3. Full-Set Survey

The second survey questionnaire, incorporating modifications as a result of the feedback obtained from the first pilot survey, was submitted to 22 PIs, including a total of 30 CRADAs. The reason for this numerical difference, again, is basically that some faculty members acted as PIs on more than one CRADA. In this case, when a faculty member had participation as PI (or Co-PI or Associate) in more than one CRADA, a separate questionnaire was submitted for each, under the assumption that there could reasonably be totally unrelated performance-wise (different companies, different subjects, etc.).

4. Survey Structure

The faculty survey contains 23 questions (see Appendix A1). Of those, 6 are open-ended [questions 2, 3, 18, 19, 21 and 22], 11 are structured [questions 1, 5, 7, 8, 10, 11, 12, 13, 15, 17 and 20] and 5 are semi-structured[26] [questions 4, 6, 9, 14 and 16]. Question 23 asks for point of contact (POC) information for an industry counterpart for

[25] The pilot survey was not actually a different questionnaire, but rather an early form of the final survey. It proved to be very useful and resulted in a few minor modifications to a number of questions and the addition of one specific question requesting point of contact (POC) information for the industry partner. Another important issue was the detection of a security problem with MS Word "macros" which did not allow PIs to complete some of the questions which required macros to execute—and hence the security level had to be lowered to allow that. One final issue was a question of *incompatibility* between PIs running MS Windows in a PC platform versus an Apple Macintosh implementation.

[26] These questions are semi-structured in that they elicit an initial selection of "binary" (Yes/No) type responses but they also request an expanded clarification of the answer.

the CRADA. The structured and semi-structured questions were intended to be metric-supporting questions, while the open-ended ones were designed to elicit additional supporting information not necessarily associated directly with any specific metric.

Regarding content, the survey is thematically organized in three blocks of questions:

- CRADA Background (3 questions).
- Objectives and Benefits (8 questions).
- CRADA Process and other Specific Issues (12 questions).

These blocks of questions provided different information in support of the research as indicated in the following table (**Table 9)**.

Survey Questionnaire Block	Information Provided
CRADA Background	General context information useful in the overall analysis.
Objectives and Benefits	This block of questions maps directly to the *effectiveness evaluation criteria* defined in Chapter V.
CRADA Process and other Specific Issues	Procedural information in support of the analysis of *best practices* and possible process enhancements.

Table 9: Thematic Organization of the Questionnaire and Specific Information Provided.

In the following section we only present responses to selected questions as necessary to support the analysis; however, the full set of responses is included as Appendix B at the end of this thesis.

D. DATA ANALYSIS AND ASSESSMENT

Data analysis constitutes the last step in the selected methodology, where the collected data is used to make judgments against the evaluation criteria defined in Chapter V.

To provide structure to this final task, we will present the analysis and results (together with germane supporting data) organized according to the "effectiveness evaluation criteria" previously introduced. Recapitulating, these criteria were defined to be:

- Scientific and Technical (S&T) Capability
- Research Quality
- Academic Impact
- Curricular Impact
- Political-Strategic

It is once more important to keep in mind the concept that the goal of this analysis is not to evaluate single CRADAs for effectiveness (although the information was collected with that granularity) but the CRADA *program* at NPS instead. For instance, an individual CRADA does not *necessarily* have to involve student work (and hence satisfy the "academic impact" effectiveness criterion) to be considered *successful*. However, the CRADA *program* must provide a *value component* in the academic dimension (somehow adding value to the educational experience of the students) to be considered successful.

Going back to the *guiding principles* enunciated in 15 U.S.C. 3710a (as cited in FLC, 2000, p. 33) introduced in Chapter III, there exists a mandatory requirement that CRADAs shall be relevant to the mission of the *laboratory*. The mission of the NPS entails two closely related domains through "advanced education and research programs" (NPS, 2004a, p. 4). Accordingly, the CRADA *program* needs to generate value in both domains to be successful[27].

[27] This is not necessarily the case for other *laboratories* which may not entail an educational component in their activities.

1. Scientific and Technical (S&T) Capability

To assess the CRADA program against the "S&T Capability" criterion, the broad question to ask—as previously established—is: *Did the CRADA program lead to an increment in scientific and technical capabilities relevant to the NPS mission?*. This question has two parts: (1) did an increment in S&T capabilities occur as a result of the program, and (2) were those S&T capabilities relevant to the NPS mission? Let us look at each part in more detail.

The answer to the first part of the question—the contribution of the CRADA program to an effective increment in S&T capabilities at the NPS—will have to be deferred to the end of the analysis, since it is really an accumulation of the results of most of the other answers and individual analyses. Therefore it will be addressed in the next and final chapter.

On the other hand, to answer the second part of the question we proposed to assess the relevance of those S&T capabilities to the NPS mission (DoD/Navy impact) by comparing the "Subject Technologies" developed through the CRADAs with objective Navy "high-value" technologies defined in official documents, like the Military Critical Technology List (MCTL), the Future Naval Capability S&T Program Supporting Technologies or the DoN Navy Technology Needs (ONR) List. We present the analysis and results using the latter document.

The middle column of Table 10 presents the "CRADA Subject Technology" for each of the CRADAs in our sample, while the rightmost column provides a cross-reference to a list of *Naval Technology Needs* compiled by the Office of Naval Research (ONR, 2005b). The cross-reference code corresponds to a list of technologies and organizational domains detailed in Appendix F.

CRADA Number	CRADA Subject Technology	ONR Naval Technology Needs
NCRADA-NPS-97-0021	Virtual Reality Transfer Protocol (VRTP) Prototype	C27
NCRADA-NPS-98-0022	Voice-Controlled Drone and Video Display Using a Wearable Computer System	A4-A8-A9

NCRADA-NPS-98-0023	Ship Systems Engineering Modeling & Simulation Development	U9
NCRADA-NPS-98-0025	MIDAS Navy Applications	T4-S6-S18
NCRADA-NPS-98-0027	Virtual Process Measurement (VPM) Methods and Software	Note 1
NCRADA-NPS-98-0026	Development of a Linear Stick Transducer	C11
NCRADA-NPS-98-0029	High-Assurance Server Support for Multi-Level Secure LAN	T1-S11-I2
NCRADA-NPS-00-0033	Pulse Detonation Technology Development	Note 2
NCRADA-NPS-00-0034	Development of High-Pressure Miniaturized Thermoacoustic Refrigeration Prototype	Note 3
NCRADA-NPS-00-0031	Design of a Classified Communications Satellite System	A5-I4-S17
NCRADA-NPS-00-0037	EW/IW Payload Enhancement for General Atomics Unmanned Aircraft	I4-M2
NCRADA-NPS-01-0039	Security Enhanced Windows CE	T1-S11-I2
NCRADA-NPS-01-0040	Effectiveness of Broadband Antenna Design	C16
NCRADA-NPS-01-0041	Identification of Military and Non-Military Vehicles and Platforms	I6-S5-T3-U5
NCRADA-NPS-01-0043	Feedback Mechanism for Agent-Based QoS Adaptive Management of Networking Resources	C18-I3
NCRADA-NPS-01-0042	Adaptive Management of Wireless C4ISR Networks	C18-I3
NCRADA-NPS-01-0036	MIDAS Navy Applications	T4-S6-S18
NCRADA-NPS-02-0045	Creep and Micro-Structural Coarseness of Lead-Free Solders in Microelectronic Packaging Applications	C19
NCRADA-NPS-02-0047	Controlled Growth, Characterization and Device Modeling of GaN	C19
NCRADA-NPS-03-0056	Unmanned Autonomous Aircraft	I4-M2
NCRADA-NPS-03-0051	Naval Ship Design	U9
NCRADA-NPS-03-0062	High-Assurance Server Support in a Multi-Level Secure Architecture	T1-S11-I2
NCRADA-NPS-03-0050	SimSecurity Game Development	C27
NCRADA-NPS-03-0052	Weather Radar Process for Rapid Scanning Tactical Radars	Note 4

NCRADA-NPS-03-0053	Integrated Software Toolbox for Aeroelastic Modeling & Dynamic Stability Analysis of Air Vehicles	Note 5
NCRADA-NPS-03-0059	Naval Simulation System (NSS) Improvement and Joint Development	C27
NCRADA-NPS-03-0061	Integrated Mechanical Diagnostics Health & Usage Management System (HUMS)	C12
NCRADA-NPS-03-0063	Non-Linear Multivariable Run-to-Run Control of Photolithography	Note 6
NCRADA-NPS-04-0067	Modeling, Simulation and Analysis of Advanced Warfare Architectures and Systems	A3-A9
NCRADA-NPS-04-0068	Multi-platform Undersea Warfare (USW) Modeling & Simulation Net-Centric Tactical Decision Aid (TDA)	S28
NCRADA-NPS-05-0073	Multi-Disciplinary Computational Tools for Naval Ship Design	U9
NCRADA-NPS-05-0074	Unmanned Vehicle Autonomous Routing System	A9

Table 10: Mapping of CRADA Subject Technologies to ONR Naval Technology Needs

Of the list of 32 CRADAs in the sample, 26 (81.25%) can be readily mapped to the list of *Naval Technology Needs* compiled by ONR (ONR, 2005b). Of the remaining six CRADAs, four can also be mapped to mission relevant current technologies: information technology (Note 1), advanced aircraft engines (Note 2), tactical weather radar (Note 4), and advanced aircraft design and analysis (Note 5). The CRADAs entitled "Development of High-Pressure Miniaturized Thermoacoustic Refrigeration Prototype" (Note 3) with Rockwell Scientific, and "Non-Linear Multivariable Run-to-Run Control of Photolithography" (Note 6) with Intel Corporation might well be relevant to the School's mission or attainment of other objectives (e.g., political) though not directly traceable to specific Navy needs.

2. Research Quality

To assess the CRADA program against the "Research Quality" criterion, the broad question to ask—as previously established—is: *Did the CRADA allow the attainment of higher order objectives in research programs and activities?* This question in turn could be answered by collecting data on (1) tangible and intangible benefits for

the research program or activity accrued through the participation in CRADAs and (2) how critical were the CRADAs in the accomplishment of the research goals of the program or activity.

For the first issue, two related questions and an itemized list were presented in the Faculty Survey:

- [Question 4] Were there specific research and academic benefits for the School established as objectives for this CRADA?
- [Question 5] To what extent were these objectives met?
- [Question 8] Check (from a list) potential benefits for the School that were realized through the CRADA. This list included seven items that were considered to be essential enablers and/or enhancements for the research activity from the previous literature review, plus an "others" item intended to capture additional inputs not included in the list. The list included:
  - Access to expertise not available within the School.
  - Access to technology and tools not available within the School.
  - Access to industry data.
  - Access to industry generated research.
  - Contractor support for project related work (manpower).
  - Funding (travel, equipment, etc.).
  - Industry exchanges.
  - Others (please elaborate in the space provided below).

The answer to the first question (Question 8: *Were there specific research and academic benefits for the School established as objectives for this CRADA?*) was totally undisputed. *All* surveyed PIs indicated that there were specific research and academic benefits particular to NPS that were established as objectives for the CRADA.

The answers to the second question (Question 5: *To what extent were these objectives met?*) are presented next. The responses from the 21 CRADAs that were

collected show (see **Figure 6**) that 81% of the respondents assess that the research/academic objectives established for the CRADA were either fully or partially (with a high percentage) met. Some of the CRADAs for which the objectives were partially met (5) are "active" CRADAs and therefore it is very possible that they will attain a higher percentage as they continue to evolve. On the other hand, it is interesting to indicate that for the CRADAs that had a low percentage of objective accomplishment, the investigators point out some of the reasons:

- Plainly, sometimes research does not lead to the results expected.
- It is very difficult to quantify how research would evolve when the objectives are being drafted upfront at the beginning of the negotiations for the CRADA.
- Sometimes, industry technology ends up not being as mature as had been originally anticipated.

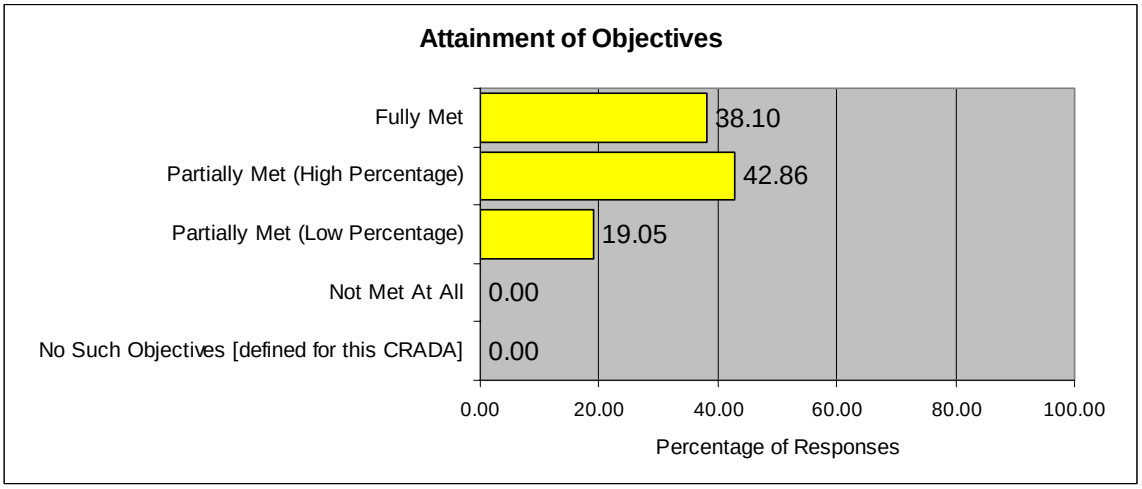

Figure 6: Attainment of Research and Academic CRADA Objectives.

Next we present the responses for the last question (Question 8) which asked for *specific research benefits for the School that were realized through the CRADA*. Out of the 21 CRADAs surveyed, the following figure (see **Figure 7**) indicates the number or responses (as a percentage of the total number of responses) that a given particular *benefit* was selected as having been realized through the CRADA.

Clearly *access to expertise, technology and tools not available within the School* and *funding* (used for different purposes) are the most important benefits. Also, as many PIs point out, the explanation for the higher number of "hits" for *technology and tools* as compared to *expertise* is that in many cases the expertise is indeed available, and rather the most up-to-date tools and technologies contributed by the industry partner are the components that really add value to the research activity.

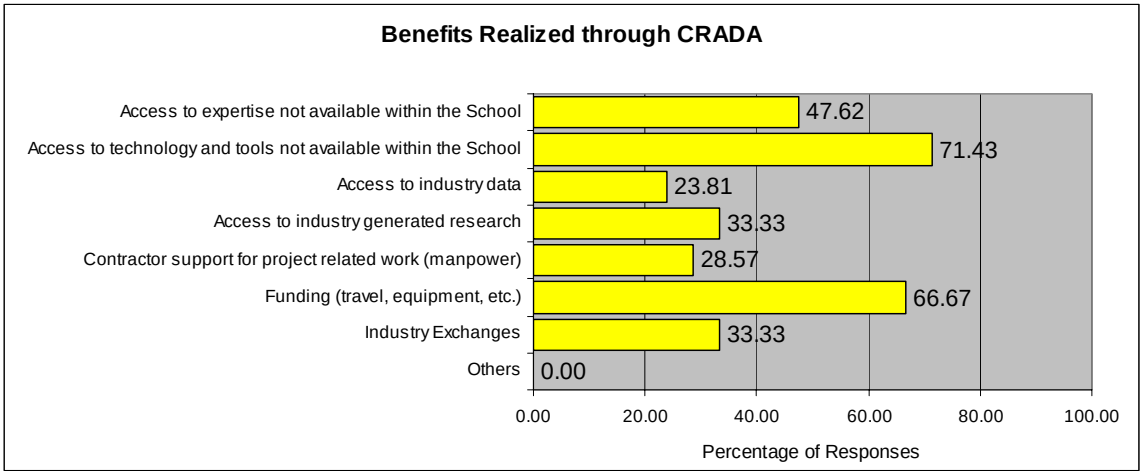

Figure 7: Benefits Realized through the CRADA.

The issue of *funding* also deserves particular consideration. CRADAs provide the *only* mechanism by which an industry partner can provide funding to support a collaborative endeavor. This funding—though small when viewed within the context of the entire sponsored research program[28]—becomes an important additional source of money to support the work of faculty and students through travel (attendance to conferences and symposia), course support material and texts, equipment and supplies, software, and also, in a few cases, a contribution to the PIs' salaries.

Although *access to industry data* did not get a comparatively high percentage of responses, its availability and use was also reported as being able to provide valuable benefits. Two of the PIs interviewed[29] (in-person interviews) for a particular CRADA with a major defense contractor highlighted the huge importance of working—statistical

[28] Total expenditures for the sponsored research program at NPS exceeded $60M for FY04 .

[29] From the NPS Department of Operations Research.

analysis—with *real-world* industry data, as compared to artificially generated or simulation data. Also, in many cases these data were previously pre-processed with complex proprietary algorithms which added substantial value to otherwise raw data. Access to these proprietary data would not have been possible without the CRADA.

Lastly, for the second information requirement, related to the "criticality" of the CRADA program on the attainment of the goals of the research program or activity, two other questions were provided in the survey, namely:

- [Question 9] Was the CRADA sufficient to meet the research needs that it was applied to? If not, in what ways was it insufficient?

- [Question 6] If the CRADA had not been established, would these objectives have been met in any other way? How (please elaborate)?

For the first question (Question 9: *Was the CRADA sufficient to meet the research needs that it was applied to? If not, in what ways was it insufficient?*) all PIs surveyed responded affirmatively.

For the second and last question (Question 6: *If the CRADA had not been established, would these objectives have been met in any other way?*) the responses are shown in **Figure 8**. This is an extremely important result: almost 60% of the PIs considered that if the CRADA had not been in place, the research activity would *not* have been possible. And there is a very important complement to that; of the 7 (33%) PIs who responded affirmatively—indicating that if the CRADA had not been established, the research would have still taken place and the objectives would have been met—4 of them indicated that although the same results could have been obtained in some other way, it would have taken *longer* to achieve.

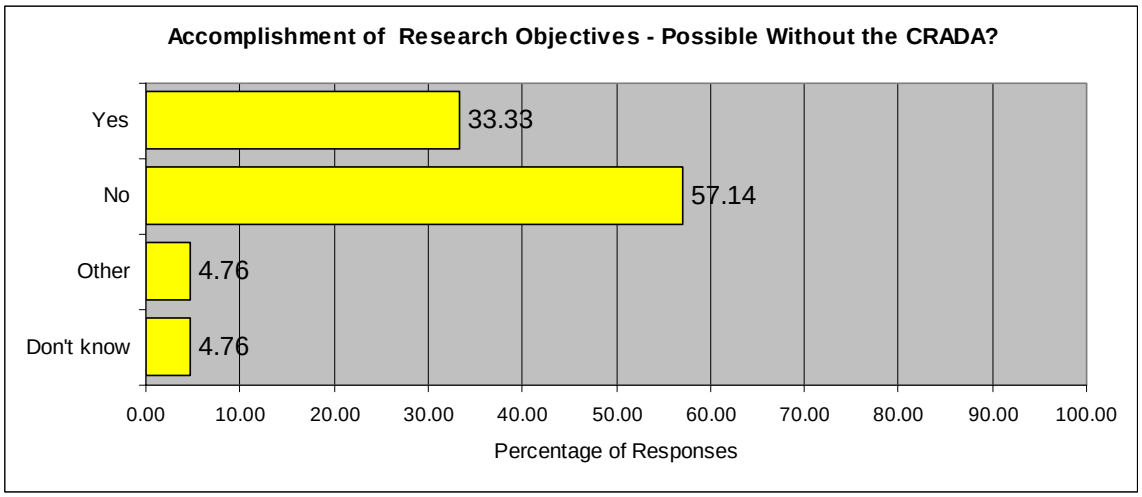

Figure 8: Alternatives to CRADAs for Accomplishing the Research Objectives.

3. Academic Impact

To assess the CRADA program against the "Academic Impact" criterion, the broad question to ask—as previously established—is: *Did the CRADA have a specific impact on the educational experience of students?* To this effect, a very straightforward question was included in the survey:

- [Question 10] Did the CRADA result in any of the following student related work?

The response was structured to select from a list including "course projects", "theses" and "other" activities, with multiple selections allowed. Again, the results are presented in the next figure as percentage of the total number of responses.

Of the 21 CRADAs considered, 17 (81%) resulted in some kind of student involvement as part of the activity, while just 4 (19%) CRADAs had faculty participation exclusively. As **Figure 9** shows, of the 17 responses that accounted for student work, 16 (94%) included theses, 6 (35%) also involved course projects, and 7 (19%) also indicated "other" student activities.

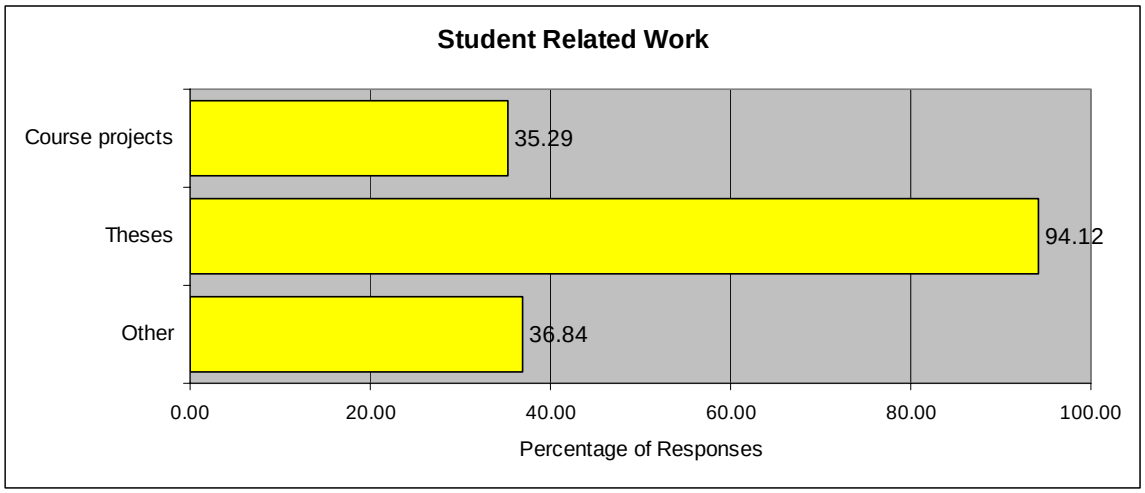

Figure 9: Student Related Work as a Result of CRADA Activity.

The respondents that selected "other" student related activities indicated:

- Publication in conferences and specialized journals.
- Participation in conferences and symposia.
- Practical application of theoretical knowledge.
- Industry exchanges and real-world interaction.
- Access to real-world data for statistical analysis.
- Access to cutting-edge technology.
- Access to state-of-the-art testing facilities.

All of these activities are also very important benefits for students realized directly or indirectly (through funding, for example) by the CRADA. The net result is a significant *enrichment* of the educational experience, which would have been extremely difficult to obtain by other means, particularly the last four as they usually involve access to proprietary or competition sensitive information.

4. Curricular Impact

To assess the CRADA program against the "Curricular Impact" criterion, the following question was included in the survey questionnaire: *Did the CRADA have an impact on the curricular design at the NPS?* In this case, this impact can be captured (among other things) by the creation of new curricula/programs or enhancements to existing curricula/programs. For that purpose, a straightforward question was asked in the survey:

- [Question 11] Did the CRADA result in updates to a curriculum or initiation of a new curriculum or academic program?

Just 3 (14%) out of the 21 CRADAs reviewed reported updates to a curriculum or initiation of a new curriculum or program as a result of the CRADA. Although the question was based on similar findings from collaborative T2 programs in other research universities (Coleman and Shelnutt, 1995), the question was perhaps too focused on a very specific—and drastic—way of assessing curricular impact. Although 86% of the surveyed PIs responded negatively, many of them also indicated that through the CRADA they were able to bring in valuable contributions to their courses and particularly "courseware". For instance, in two occasions, instruction materials developed specifically for the industry partner were subsequently used extensively for the benefit of NPS courses.

One of the CRADAs that produced a significant curricular impact is the one entered into by NPS with Northrop-Grumman Ship Systems (NGSS) of Pascagoula, MS. This CRADA resulted in the establishment of an innovative cooperative environment between an NPS institute (Wayne E. Meyer Institute of Systems Engineering) and a sponsoring private company. The CRADA allowed a specific program entitled "Total Ship System Engineering" (TSSE), instituted in 1991, to receive an invaluable collaboration from the industry partner (NGSS). This support materialized in the following (among others) specific CRADA tasks for NGSS in support of the aforementioned program:

- Proposals for of theses and other research ideas.

- Participation in design reviews for course and capstone projects.
- Provision of a Visiting Professor[30] (from NGSS), resident at NPS.
- Provision of funding.

Through the CRADA, NPS and NGSS also established joint coordination mechanisms for design topics, research areas and mutual visits to relevant sites and facilities. As pointed out by the then TSSE Chair, Prof. Charles Calvano, in an interview when the agreement was signed:

> The CRADA represents an unprecedented opportunity to introduce real-world industrial viewpoints into the students' academic design projects, making those projects of even greater value to the students and of increased relevance to the Navy (NPS Research, 2003, p. 40).

5. Political-Strategic

Finally, to assess the CRADA program against the "Political-Strategic" criterion, the broad question to ask—as previously established—is: *Did the NPS benefit politically from participation in the CRADA?* These political and strategic benefits are *extremely* difficult to quantify to even a very modest degree of accuracy, mostly because they are completely based on *perceptions*.

Bozeman states that political impact "does not yield to systematic evaluation" (Bozeman, 2000, p. 647). He also indicates that this value is "instrumental, a means to an end" (Bozeman, 2000, p. 648). Other possible ways to evaluate political impact are also presented by Bozeman (as a result of perceptions generated in policy superiors and decision makers):

- Through consideration of increased funding or other resources resulting as a *reward* from participation in the T2 activity.

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30 This agreement resulted in the establishment of the "Northrop-Grumman Ship Systems Chair Professorship" at NPS. The qualifications of the individual selected for that position brought over forty years of industrial engineering experience to the program. During 2003, that visiting professor from NGSS, Prof. Bill Solitario, acted as the overall coordinator of the System Engineering and Analysis (SEA) capstone design project, as an advisor for the TSSE program and student projects, and as instructor for a particular upper-level seminar course.

- Through recognition as a "good industrial partner" as a result of the T2 activity (awards[31], events, media impact, etc.).

- Through rewards for the *appearance* of active and aggressive pursuit of T2 in support of a specific community of interest, region, State or local agencies, etc.

One way to capture a relative/comparative measure of the increased visibility and name recognition of NPS in the defense, academic and corporate environments is through a characterization of the *counterparts* in the agreements. Collaboration with world-class industry partners provides *increased* visibility and awareness[32] of NPS in the "appropriate circles". The validity of this analysis to support the proposed evaluation criterion rests in the assumption that teaming up with world-class defense corporate partners (through effective marketing and dissemination of the existence and results of the collaborative endeavor) will increase external *awareness* and visibility of the School. The more relevant the corporate partner in the defense community—*ceteris paribus*—the higher the degree of political benefit that results from external awareness of the agreement.

A quick look at some of NPS industry partners from our sample reveals that over 65% of them are among the largest and most renowned U.S. corporations. In the civilian sector, companies like General Electric, Microsoft, Cisco Systems, Intel Corporation and SBC Communications are *all* among the 50 largest corporations of the world in market value[33].

On the other hand, corporations like Lockheed-Martin, the Boeing Company, Northrop-Grumman, BAE Systems Information Technology, General Electric Aircraft Engines, TRW, United Defense LP Armament Division, General Atomics Aeronautical

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[31] A prominent display of prestigious awards for excellence in T2 is a key highlight of the Naval Air Warfare Center Weapons Division (NAWCWD) China Lake Technology Transfer website. (Online) at http://www.nawcwd.navy.mil/techtransfer/awards_2.htm#FLC00

[32] This approach is based on a similar criterion suggested by the NPSFI *Transformation Center Business Plan* (NPSFI, 2004).

[33] According to the Forbes Global 2000 List, sorted by "market value": General Electric (2), Microsoft (3), Intel Corporation (16), Cisco Systems (27) and SBC Communications (45). (Online) at http://www.forbes.com/2005/03/30/05f2000land.html

Systems, and BF Goodrich are undisputed world leaders in the defense sector. *All* NPS industry partners in this category rank among DoD top 100 companies and subsidiaries, receiving the largest dollar volume of prime contract awards for Fiscal Year 2004[34].

Again, this is just one approach to capturing a *surrogate* measure for the "political" impact resulting from collaborative endeavors with industry. It is a *surrogate* in the sense that—being a "means" rather than an "end"—the political impact is hardly ever explicitly stated as part of the objectives of an agreement. Nonetheless, the highly sought-after "end" (specifically, the perception of increased visibility for the School and name recognition) is indeed a stated objective in documents like the *Transformation Center Business Plan* (NPSFI, 2004).

[34] According to the OSD Index of "DoD Top 100 Companies and their Subsidiaries – FY2004": Lockheed-Martin (1), Boeing (2), Northrop-Grumman (3), United Technologies (7), BAE Systems (12), General Electric (14), General Atomics (68) and BF Goodrich (70). (Online) at http://web1.whs.osd.mil/peidhome/procstat/p01/fy2004/top100.htm

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VII. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

The effectiveness evaluation criteria and metrics introduced in Chapter V were used in Chapter VI to accomplish the proposed evaluation task, using the NPS CRADA program as the subject for the analysis. Through the initial data collection task, and subsequent data analysis and assessment phases we were able to derive useful *partial* observations and results. It is our intent in this final chapter to present a few conclusions that—in our opinion—capture the fundamental themes ensuing from this research.

This final analysis and articulation of conclusions will also take advantage of two blocks of questions from the Faculty Survey (CRADA Background and Process and other Specific Issues), which were not designed to contribute to the assessment of the *outcomes* of the CRADA program—as supported by the effectiveness evaluation criteria—but rather to assess the CRADA *process* itself.

Lastly, inputs from the numerous direct interviews conducted with key actors in the process plus a few Industry Partner surveys collected will also be used to support and illustrate specific ideas.

1. Effectiveness Evaluation Criteria and Metrics

It has been proposed that it is entirely possible to define and use appropriate effectiveness evaluation criteria and metrics to provide valid and reliable information about the value added by CRADA programs in the specific domain considered. These criteria and metrics were selected reflecting on three critical aspects: (1) the inherent *complexity* of the measurement object, (2) the critical importance of the *context*, and (3) the need to be able to deal with *perceptions* as objectively as possible.

The data to support the analysis was collected from a sample of agreements (among other relevant data). Although this data collection task was performed at the individual agreement level—with direct input from the Principal Investigators—the object of the assessment was *not* the individual CRADA but rather the CRADA *program*.

This distinction is particularly important, since it is the aggregation of outcomes that defines a common goal and an institutional direction.

Five critical dimensions of effectiveness were defined for the particular domain of NPS (a federally funded research university with a unique expertise in the defense environment). These critical dimensions were used to provide the framework *and* the rationale for the evaluation task: (1) Scientific and Technical (S&T) Capability, (2) Research Quality, (3) Academic Impact, (4) Curricular Impact, and (5) Political-Strategic.

Finally, since these dimensions were derived from higher-order strategic policy and guidance documents, the ensuing analysis and assessments could thereupon be directly traced to the School's mission and strategic initiatives. The final results from the assessment are presented below in the answer to the *primary research question*.

2. Technology Transfer, Information and Intellectual Property

Technology transfer is as much about *information* as about anything else. At the core of the any technology transfer endeavor one finds data; and *it is all about the data*: developing, moving, securing, sharing and protecting data. These data, structured and placed into suitable contexts—as knowledge, expertise and know-how—are ultimately the main *commodity* and the object of the transfer.

It is not at all strange therefore, that so much effort goes into ensuring that effective mechanisms exist to protect the data and to be able to exercise proper ownership of them. This explains the oftentimes *obsessive* zeal exhibited by many industry partners—particularly in public-private interactions—when *intellectual property* issues and *data rights* are being negotiated as part of a T2 agreement. These negotiations can *make or break* a deal and consume a large portion of the resources—especially *time*.

In an interesting study prepared for the Department of the Air Force by Trotta Associates (2003), entitled "Assessment of Industry Attitudes on Collaborating with the U.S. Department of Defense in Research and Development and Technology Sharing" this issue is addressed in a very clear and concise way:

> Competitive knowledge and information costs money to develop and protect, and has value in the marketplace. Intellectual property can be the lifeblood of a firm. Intellectual property may include engineering know-how, designs, strategic plans, manufacturing processes, or knowledge of emerging markets. Many companies consider sharing intellectual property with the government a risk, especially if it also has commercial application. Protection should be a standard element of contracts unless waived by the contracting owner of the proprietary information at issue. The federal government should also train its people to protect business proprietary information with legal penalties supporting its protection (Trotta, 2003, p. 4).

In a typical standard CRADA document, over 65% of the text[35] is related to data—defining, marking, classifying, assigning specific rights, and specifying proper procedures for publication, licensing and patenting of inventions resulting from the cooperative work. Likewise, negotiations about *data rights* normally consume a substantial portion of the CRADA negotiation time; the more valuable the data—and generally, the larger the industry partner[36]—the more arduous and longer the negotiations.

On the other hand, data rights are neither exclusive of cooperative agreements nor of technology transfer endeavors. Data rights are a very important aspect of any *contractual* agreement between public and private entities and also among themselves. The U.S. Government has developed and enforced very specific policy and directives to insure that intellectual property issues are duly addressed in its dealings with the private community through *contracts*. For the particular case of the Department of Defense, intellectual property issues and procedures are addressed in *Defense Federal Acquisition Regulations Supplement (DFARS) 227* (DOD, 2005).

One key distinction that needs to be remembered, though, is that CRADAs are not contracts, and therefore are not governed by FARs or DFARS. In the interest of promoting and facilitating collaborative work and more expedient resolution of the agreements, less stringent requirements regarding negotiations of rights were allowed, by

35 Of the main body of the document, not including the "statement of work".

36 One could ironically argue that this is directly proportional to the number of lawyers involved.

design. However, this distinction creates—for CRADAs—a certain *friction*, since industry counterparts (again the larger, the more prevalent the behavior) normally tend to think in terms of FARs and DFARS anytime they deal with the Government, and this usually engenders needlessly longer—and sometimes quite bitter—negotiations and disputes.

Summarizing, information is the critical *commodity* in the technology transfer domain. Knowledge created or evolved through collaborative endeavors (such as CRADAs) as a result of cooperative work becomes *intellectual property* that needs to be shared, secured, and protected fairly and effectively. CRADAs provide effective mechanisms to ensure that these issues are appropriately addressed, for the benefit of both partners. Nonetheless, negotiations about intellectual property—particularly data rights—usually end up getting bogged-down in legal *labyrinths*, and hence adding unnecessary delays to the CRADA establishment time. We will revisit this issue in the next two conclusions.

3. Trusted Relationships

Of the 21 CRADAs considered in our survey sample, roughly half of them originated in a demand from industry and the other half from NPS demand[37]. In almost all instances, the Principal Investigators (PIs) surveyed were part of the initial steps of the process. How CRADAs *start* and how CRADAs come to *fruition* are inevitably connected—at least in the perceptions of the PIs—to more subtle and at the same time substantial things than simple advertised technology opportunities and commercial demands.

Although related specifically to the CRADA process, one question in the Faculty Survey was also intended to enlighten our understanding of certain perceptions of PIs, regarding what things were important—and what thing were not—in order to *engender* healthy, productive and long-term R&D collaborative partnership with industry [Question 20]. The question specifically asked how particular measures would contribute to

[37] The exact distribution of responses also includes three CRADAs whose origin was reported by PIs as somehow *undefined* in the sense that there was no distinct demand from any party, but rather a synergistic approach through mutual interest.

obtaining better results from the cooperative research programs and activities with industry at NPS. Five possible measures were suggested (with a five-point rating scale from Extremely Useful to Not Useful), and additional space was provided for suggestions. One of the measures suggested was focused specifically on the issue of *trust*, namely:

- [Question 20b] Promoting additional mechanisms to build a trusted relationship with industry (work for service, industry exchanges of faculty/students, consortia, etc.).

For this measure, 86% of the surveyed PIs coincided in pointing it out as a positive measure (Extremely Useful (22%), Very Useful (28%) and Useful (36); see the complete responses in full-detail in Appendix B).

Although these numbers show a definite trend in the responses, a more fundamental aspect was revealed through comments made during direct interviews with some of the PIs—and later corroborated from industry counterpart interviews—which came as a surprise to the author: the foundations on top of which successful agreements were built, were established long before formal negotiations for the agreements were even started. From the beginning, there was already an *informal network* of personal and professional relationships[38], people (and their perceptions), which embodied an essential prerequisite for successful collaborative endeavors: *trust*.

Whereas, as was previously argued, *information* is the essential component of technology transfer (T2), *trust* is the unrivaled foundation—and enabler—for T2 *collaborative* endeavors. And *it is all about trust*. Any efforts[39] made to generate and nourish an open environment of trust are invaluable, as they foster strong and healthy cooperative relationships that will bring about successful agreements and partnerships.

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[38] In many cases, former NPS graduates and faculty (now working with industry) were on the industry side of the partnerships. Their knowledge of NPS capabilities—and people—was instrumental in generating and setting up the CRADAs.

[39] Some examples of these trust-building efforts may include: (1) students and faculty visits and exchanges with industry partners, (2) participation of industry representatives in NPS sponsored events (conferences, symposia, field experiments, etc.), and (3) interactions through intermediate organizations—consortia, forums, etc.).

An interesting examination of the critical importance of mutual respect and trust in T2 is presented by Bennett (1996). Although specifically concerned with software technology transfer, the validity of the analysis extends to other domains as well. Bennett states that "attention to creating, reinforcing, and maintaining respect and trust is implicit in all the strategies for successful transfer" (Bennett, 1996, p.35). Discussing the issue of team building and trust in university-industry partnerships, Williams (2002) also discusses how "keeping secrets is often the downfall and the end of a partnership" (Williams, 2002, p. 4).

Finally, this issue of *trust* is closely coupled to the previous discussion about legal concerns and the difficult intellectual property negotiations that ensue during the establishment of a CRADA. From the start, trust exists at the *personal* level between collaborators and counterparts—scientists on both sides of the agreement. Nevertheless, this same trust needs to be built and documented at the *institutional* level, where (much to the frustration of the *working* collaborators) things are a lot more bureaucratic and take significantly longer time to settle.

4. Marketing of Technology Transfer at NPS

Another possible measure suggested to PIs in the survey questionnaire in regards to particular measures that would contribute to obtaining better results from the cooperative research programs and activities with industry at NPS dealt with the issue of marketing of T2 opportunities more effectively. The proposed measure was worded as:

- [Question 20a] Increasing industry awareness of specific opportunities for cooperative research at NPS.

In this case too, 86% of the surveyed PIs coincided in pointing it out as a positive measure (Extremely Useful (7%), Very Useful (50%) and Useful (29); see the complete responses in full-detail in Appendix B). This being the case, NPS does not seem to be doing a very effective job in marketing its technology transfer opportunities. One of the industry partners interviewed put this very bluntly:

> There is little visibility into the work that NPS could support—they don't "advertise" well. How do you find opportunities for a CRADA? You do it by looking into literature and then looking for people that are doing things you are interested in (technical advertising). I know NPS instructors publish in INFORMS, but it so happens that no one interested in my field of study reads those publications. Additionally NPS does not send people to conferences I go, so—without prior knowledge of NPS—I would not have contacted them.

This response clearly indicates that NPS needs to do a better job in the *marketing* or *advertising* of its capabilities in the area of technology transfer as an effective enhancement in the process of reaching out to contact new partners and opportunities. In this regard, one interesting possibility is to implement a *research portal* where prospective partners can look for T2 opportunities with NPS. This research portal[40] could also be used as an effective mechanism to enhance the dissemination (both internal and external) of CRADA results, which was also pointed out as a positive measure by 67% of the PIs in the survey. Some other novel ways to approach the marketing of T2 are presented below, in the section entitled "Innovative Marketing of Technology Transfer Opportunities".

5. Procedural Aspects of CRADAs

We stated in the introduction of this thesis that CRADAs were designed to be developed and implemented much more expediently and rapidly than traditional mechanisms, for example contracts. Flexibility, ease of implementation and reduced administrative overhead were supposed to be *built-in* features of the CRADA process. Nevertheless, we have also seen that real-world implementations do not necessarily match those intentions too closely (due to a variety of reasons, mostly legal and administrative concerns) and that oftentimes, much to the dismay and frustration of the

40 An excellent example is the research portal of the University of Illinois at Urbana-Champaign (UIUC) (http://www.uiuc.edu/research). Research initiatives, services and resources, are presented by major academic units, including a brief overview and references to published results. The Office of Technology Management (OTM) page includes a searchable database of available technologies for transfer opportunities at http://www.otm.uiuc.edu/techs.

collaborators, negotiation times for CRADAs ended up taking *years*[41] before any real collaborative work could even start to happen. This is clearly unacceptable.

One of the most important results presented in Chapter VI was related to the fact that the majority of the surveyed PIs considered that if the CRADA had not been in place, the research activity would *not* have been possible. Furthermore, for those PIs who indicated that if the CRADA had not been established, the research would have still taken place (and the objectives would have been met in some other way), most of them also pointed out that although the same results could have been obtained, it would have taken *longer* to achieve.

For the researcher, time to reach the purposed objective is essential; as essential as reducing the time-to-market (by applying the knowledge generated through the cooperative work) is to the industry partner. *Time* is vital. It follows that *any* measures that can be adopted to reduce CRADA negotiation time shall add enormous benefits to the process itself—and undoubtedly to the *opportunity value* of the outcomes as well.

In the Faculty Survey, we also tried to elicit suggestions from the PIs regarding this problem. While 86% of the surveyed PIs agreed on the need to *simplify and reduce the administrative-bureaucratic steps required to set up the agreement* and to *reduce the time required to set up the agreement* as absolute desirables, most of them, on the other hand, were not particularly enthusiastic in furnishing procedural suggestion for improvement. And this is perfectly understandable. PIs *do not care* about the process, it is not their responsibility. Their responsibility is the collaborative *work*, not the negotiations.[42]

On the other hand—as expected—we collected useful suggestions from the RSPO staff and legal counsel interviews. To no surprise, all of these suggestions focused on procedural *bottlenecks*, particularly legal issues and cross-institutional negotiations. An unusual situation at NPS was also highlighted that contrasts the significant growth in the

41 Two paradigmatic CRADA cases at NPS have taken *two* and *three* years to establish. A third case is close to *four* years since negotiations started, and has never come close to a final agreement yet.

42 Very interestingly 86% of the surveyed PIs did not view *increasing faculty and staff training in technology transfer related activities* as a very useful measure; it is not their concern; the ORTA should be doing that!

number of agreements in the last few years, *which has not been matched by a similar growth in internal capabilities*, basically resulting in an *understaffing* situation that adds unnecessary delays and backlog to the already slow negotiation process.

In the section entitled RECOMMENDATIONS, below, we present a few suggestions that could be used to attempt some innovative actions designed to produce significant reductions in administrative overhead and processing time.

B. ANSWER TO RESEARCH QUESTIONS

1. How effective have been Cooperative Research and Development Agreements (CRADAs) in generating value for the federal partner (NPS)?

Based on the effectiveness evaluation criteria introduced in Chapter V and the assessment of the data collected—through multiple information gathering resources—presented in Chapter VI, we maintain that the NPS CRADA program, though still far from perfect, has produced *significant* value to the School in the accomplishment of its mission.

Through participation in CRADAs with world-class industry partners, the NPS has generated value-enhancing *content* to enrich—both—the educational offering to its officer students and its relevant and unique expertise in critical military capabilities demanded by its sponsor agencies.

To support these findings, we propose that the sample[43] of CRADAs selected was representative of the complete spectrum of cooperative agreements, past and present, which the School has used to create some very productive, effective, and enduring partnerships with industry. Further, we also uphold that the evaluation criteria used to assess the NPS' CRADA program were valid and provided the necessary rationale and framework over which a critical analysis could be judiciously based.

[43] Our sample for the document review included the totality of CRADAs entered into by the School since 1992. For the survey questionnaire, and based on the sampling criteria explained in Chapter VI, we selected 32 CRADAs (almost 50% of the total). Responses for the survey provided quantitative and qualitative data for 19 out of those 32 CRADAs (60%).

Three main methods provided the necessary data: an extensive document review, a comprehensive set of direct interviews with key stakeholders (on both sides of the agreement) and lastly, the survey questionnaire for industry partners and faculty. Although many questions formulated to the PIs and industry counterparts in the surveys (on which a substantial portion of our research is based) were clearly subject to personal *perceptions*, there is convincing evidence that—by mere inspection of the results—the responses provided did not convey self-reported commendation; rather, they reflected a critical understanding of the purpose of the evaluation, oftentimes with even a great degree of candor and bluntness.

Specific value-generating benefits accrued as a direct result of the CRADA program at NPS were presented in Chapter VI, and they include:

- A great enhancement to the research programs and activities, basically through access to expertise, cutting-edge technology, data and tools not available within the School.

- A substantial enrichment of the student academic experience through support for theses, course projects, and other important activities (such as industry exchanges, participation in conferences and symposia, etc.).

- A perception of increased visibility and name recognition of NPS among peer institutions, which has a definite political and strategic impact.

2. What metrics are appropriate to measure the institutional value generated by CRADAs in the academic/research environment, particularly for the federal partner?

Five "effectiveness evaluation criteria" and a small sample of associated metrics were presented in Chapter V which, in our view, satisfied a set of pre-established guiding principles (complexity, context focus and the ability to capture both tangible and intangible properties objectively). The criteria introduced were:

- Scientific and Technical (S&T) Capability

- Research Quality

- Academic Impact
- Curricular Impact
- Political-Strategic

These criteria were designed—and were expected—to provide an assessment of value in the *two* critical dimensions that are specific to the NPS environment: *research* (a domain populated by researchers/scientists) and *academic* (a domain populated by students). This *duality*—which is inherent in the nature of the NPS—became a pivotal element of our argument; to be successful the CRADA *program* had to simultaneously satisfy effectiveness criteria in *both* domains. S&T capabilities and associated research quality are essential components, and so are students.

The last interview conducted for this research, was held with the Director of the Research and Sponsored Program Office (RSPO), Danielle Kuska, who is the School's highest technology transfer official—the ORTA. While discussing the critical importance of the academic dimension, she articulated, with exceptional clarity, the following concept (in relation to the need of ONR to recognize the particular environment at NPS, when assessing CRADAs):

> It's important to understand what we are: we are not a *lab*. Our intellectual property, our technology transfer … it's mostly the students' experience and then, industry's experience; that exchange. It's not like we're going to come up with some commercial prototype that we're building.

To conclude, to be able to support the required sense of institutional *utility* (and hence justify the notion of *value* at the highest level of aggregation) these criteria were traced back and matched to supporting high-level policy and guidance. Past and present outcomes were evaluated in their contribution to the accomplishment of the School's mission (once again, a legal mandate established for CRADAs) while the *NPS Strategic Plan* (NPS, 2004a)—particularly the *strategic initiatives*—provided the link to the vision, and therefore, to the future.

The proposed effectiveness evaluation criteria were then used in Chapter VI to conduct the assessment of the School's CRADA program, and finally, in this last chapter, to support and illustrate the foregoing conclusions.

3. Based on the previous analysis, what recommendations can be made to complement and enhance the CRADA process?

For structure and clarity, the answer to this question is presented in the next section.

C. RECOMMENDATIONS

Based on the foregoing analysis and discussions, we close this thesis with a selection of recommendations which, in our view, would contribute to obtaining even greater and more *effective* results from the School's CRADA program.

1. Processes and Best Practices

We reviewed the CRADA process in Chapter III. We then analyzed the procedural aspects of CRADAs in this chapter as one of the essential conclusions to consider, among the many issues that merited further treatment from the findings of our research. In those conclusions, we stated that CRADA *negotiation time* became an overarching concern that needed to be addressed. *Any* measure that contributes to reducing this CRADA negotiation time would be highly beneficial to an improvement of the overall process—and indirectly, to potential impacts on the outcomes.

One important factor to keep in mind, though, is that CRADAs are legally binding documents. There is so much "improvement" and "rationalizing" that can be obtained—normally to some type of tailoring or optimization—but nonetheless, the fact remains: legal negotiations are difficult, time consuming and attention to detail is paramount, particularly among public-private boundaries. Two specific procedural issues will be briefly presented:

a. Standard and Non-Standard CRADAs, Limited Purpose (LP-CRADAs) and Umbrella CRADAs

There are just two mechanisms whereby work with industrial partners can be undertaken: CRADAs and Work-for-Services[44]. For CRADAs however, there are a few variants which could be more precisely tailored to specific applications. Using the right type of agreement can save a lot of unnecessary paperwork and hence effectively reduce administrative lead time, when specific conditions are met.

Navy CRADAs come in two different *flavors*: Standard and Non-Standard. The basic differences[45] between the two types of CRADAs are presented in the following table (**Table 11**).

	Navy Standard CRADA	**Navy Non-Standard CRADA**
Data rights	Data rights are shared.	Government data rights are suspended.
Funding	• Funds flow only one way (from non-Navy collaborator to Navy). • Or each funds its own work. • Under $1 million.	• Funds flow only one way (from non-Navy collaborator to Navy). • Or each funds its own work. • Over $1 million.
"Boiler plate" language	Language remains unchanged.	Language changes[46] have been made.
Foreign partner	No foreign collaborators.	One or more foreign collaborator(s).

Table 11: Differences between Navy Standard and Non-Standard CRADAs (ONR, 2005a).

Needless to say, the Standard CRADA usually takes significantly less time to establish and negotiate. For instance, although the School's President has signature

[44] Work-for-Services were explained in Chapter IV.

[45] Other possible things that can make a CRADA *non-standard* include: (1) more than two parties involved, and (2) CRADA duration is more than three years.

[46] The ONR's *Navy Standard Cooperative Research and Development Agreement Handbook* (ONR, 2002a) clearly details which articles need to be used without modification (and which can be substituted for alternative language) for a CRADA to qualify as a *standard* CRADA.

authority in both cases, each Non-Standard CRADA has to go for review to ONR *before* final signatures are authorized. The review process (both by the internal legal counsel and the external ONR office) takes considerably longer for Non-Standard CRADAs.

Another particular type of CRADA is the Limited Purpose or LP-CRADA used for equipment or material transfer. These CRADAs are used when a Navy laboratory and a non-Navy partner are interested in exchanging existing equipment or material needed to conduct research, test, evaluation, development or engineering activities[47]. Distinctively, although there is mutual interest in the results of the ensuing activity (and reports are therefore generated), *there is no joint work performed*. Intellectual property issues are duly addressed.

LP-CRADAs require much less paperwork and processing time[48]. In many instances they can be used as an effective *exploratory* venue, which may be employed to evaluate the benefits of pursuing further collaborative work (through a *standard* CRADA, for instance).

> Acceptable collaborative purposes include determining suitability of the equipment or material for the Recipient's purpose or to determine if there is mutual interest or need for a more formal CRADA, a patent license agreement or procurement (ONR, 2003, p. 1).

Finally, another *type* of CRADA which has a great potential for reducing administrative overhead and processing time is the so-called "umbrella" CRADA. An umbrella CRADA is *not* a predefined type of agreement—at least not in any official guidance or directive—but instead it is a *concept*. Umbrella CRADAs, sometimes also referred to as "blanket" CRADAs, have been used for some time at NPS with significant success in reducing settling time and making negotiations less burdensome.

An umbrella CRADA contains the standard sections (definitions, responsibilities, representations and warranties, intellectual property, liability, general

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47 The agreement can be *bidirectional*, i.e., each partner can act as either *recipient* or *provider* for the equipment or material.

48 The "model" Navy LP-CRADA is 7-pages long compared to the 34 pages of the "model" *standard* CRADA.

provisions, etc.) that *all* work performed under the CRADA must meet. The details regarding tasks, funding, deliverables and milestones, period of performance, funding and even *data rights* are included in the Statement of Work (SOW) as attachments—initially (or amendments, afterwards)—to the original signed document. As long as new related work can be added to the CRADA without changing the established conditions, there is no need to write and approve separate agreements, just the new SOW; and this saves an enormous amount of paperwork and time

b. Focused Negotiations (Legal-ORTA-Contract)

One issue that consistently appeared in our discussions with the RSPO Director and the NPS legal counsel was how difficult and slow negotiations occurred when on the other party was not a spokesperson with matching domains of regard. For instance, legal discussions were cluttered oftentimes when contracting people wanted to interpret the *small print* regarding intellectual property and data rights applying—wrongly—the criteria set forth in the DFARS (because they did not know better).

In some other cases, during our document review phase we came across e-mail exchanges between RSPO staff, the legal office and the PIs which involved complex legal issues, in which—at least in our view—the PIs did not contribute any considerable information but rather seemed to be caught in the middle of incomprehensible rhetoric.

The recommendation that we offer here is very straightforward and simple. Keep the negotiations focused by clearly demarcating domains of regard; and making sure that on the other end of the discussions (at the industry partner's) the same understanding applies. ORTA to ORTA, legal to legal or even ORTA to legal in some cases, but avoid ORTA or legal to contract or PI to legal interactions[49]. These last types do not add value to the exchange and produce not only process inefficiencies but also undesirable confusion and frustration.

[49] PI to legal interactions *within* the organization are proper in certain cases (for example, PIs may sometimes require counseling by their legal offices). Most other interactions should be channeled through the ORTA. PI to legal interactions across organizational boundaries, though, are entirely discouraged.

2. Curricular Impact and Industry Sponsored Programs

In the previous chapter we introduced a particular NPS CRADA with Northrop-Grumman Ship Systems (NGSS) entitled "Navy Ship Design" (NPS-NGSS, 2003) which generated significant value in a dimension that we defined as *curricular impact*. This CRADA allowed a School program (Total Ship Systems Engineering) to receive an important contribution from the industry partner through specific programmatic enhancements: coordination of design topics, industry real-world input and sharing of know-how, visits and access to facilities, funding, and even a professorship from NGSS resident at NPS. Though extremely relevant, this type of CRADA is the exception rather than the rule[50].

The question is how to promote and establish more programs like this, which indisputably add value to the School academic offering. Coleman and Shelnutt (1995) discuss the benefits wrought by industrial partner sponsorship of capstone design project at universities. Although we have so far addressed only the benefits for the School, it is important to point out, as Coleman and Shelnutt do, that in order for these collaborative efforts to succeed, the industry partner also has to perceive and realize an equivalent amount of *value* from the endeavor.

The NPS-NGSS CRADA states that many of the studies and design issues resulting from the sponsored program can effectively complement Independent Research and Development (IRAD) projects conducted at NGSS (NPS-NGSS, 2003). The NPS needs to maximize its competitive advantage, offering its "unique interdisciplinary defense focus which is not available in the private sector on science, engineering, technology, policy, operations, management and international relations" (NPSFI, 2004, p. 5) as *trading currency* in negotiations with prospective partners to generate more CRADAs—like the NGSS agreement—that produce a significant curricular impact for the School.

[50] The process of introducing changes to a curriculum at NPS is complex. Each curriculum has a designated sponsoring organization within the DoN that *owns* the program. Creation of new curricula and updates to existing programs are regulated by OPNAVISNT documents and internal NPS regulations. Curricular reviews are held every two years and this is the opportunity when changes can be introduced (either required by the sponsoring organization or proposed by NPS and approved by the sponsoring organization).

3. Innovative Marketing of Technology Transfer Opportunities

We have argued—based on the observations and analyses made during the progress of this research—that the establishment of a *trusted relationship* among the partners is an essential prerequisite to a successful public-private collaborative endeavor. We have also pointed out that increasing the external awareness of technology transfer opportunities at NPS (for instance, through suitable advertisement and marketing techniques) is an important way to reach out to a larger pool of potential partners and hence increase the number of possible partnerships (and this was corroborated by 86% of the surveyed PIs).

Innovative ideas and proactive organizations are more likely to produce better results from these *outreach* activities than simply setting up a well designed *website* that contains a mute repository of technology opportunities at NPS. The Naval Postgraduate Foundation's (NPSFI) *Transformation Center* was briefly introduced in Chapter IV as a pioneering entity created with the intent, among other things, of facilitating technology transfer activities—CRADAs in particular—between industry partners and NPS' institutes and research centers.

The creation of the *Transformation Center* (TC) is aligned with one of the School's strategic initiatives (STI3), also presented in Chapter IV, which required an "increase the number of meaningful partnerships and available markets for our services" (NPS, 2004a, p. 7). Among its stated objectives, the TC is intended to *consolidate* and *reenergize* three services at NPS (NPSFI, 2004, p. 3):

- Promote innovative partnerships between NPS faculty and U.S. industry, designed to identify and support high-impact R&D projects.
- Develop and conduct an aggressive exposure and marketing effort, combined with legal support, which facilitates and accelerates rapid technology transfer.
- Foster imaginative and innovative opportunities to exchange technological research for national defense.

The TC is more than just a technology *broker* for the School; it is really a *forum* through which industry partners and technology providers within the School participate

and interact, and through this interaction, start building the desired trusted relationship. The TC is not intended to replace the RSPO or ORTA functionality but rather to effectively complement it. To accomplish this objective, the TC takes advantage of an innovative mechanism known as *partnership intermediary agreements* (PIA).

By entering in a partnership intermediary agreement (see definition in Chapter I) with the NPSFI TC, the School authorizes the TC to act as an intermediary entity responsible for coordination of activities (on behalf of NPS centers and institutes) with prospective industry partners and educational institutions for the promotion of cooperative or joint R&D activities. These activities include hosting periodic technology transfer expositions at NPS, hosting (or co-hosting) symposia and other technical events, developing and maintaining an up-to-date T2 opportunities website, and preparing and disseminating marketing material (NPSFI, 2004).

PIAs are a fairly recent development—the first U.S Navy PIA was signed in May 2003—and are an example of innovative ways of conducting business in the T2 domain. If, as previously suggested, *trust* is such an important contributor to the success of cooperative agreements, and—through mechanisms like PIAs—intermediate organizations like the TC can foster and nourish these trusted relationships, then this is great example to follow.

4. Tools and Technology Support (IT)

We presented the CRADA process in some detail in Chapter III. From *Concept Definition* to the final executed version of the CRADA there are literally hundreds of exchanges of information among the participant stakeholders, which are required to initiate, negotiate, set up and start the agreement. In addition to the PIs and their counterparts with the industry partner, many other events generate bidirectional requests of information, reviews, and clarifications, mostly involving people from technical, legal and contractual staffs.

Though more effective and agile, the advent of the Internet, and particularly e-mail, has increased manifold the number of exchanges. And so these developments have

increased proportionally the amount of information filed and stored for each CRADA—in electronic form and hard copy too. Most of the current CRADA files to which we had access at the NPS RSPO have the thickness of a 400-page book; and this just *partially* captures the total amount of information interactions spawned during the process (for instance, phone conversations and in-person meetings are not captured).

In recent times, the use of *collaborative tools* has started to gain wider acceptance in the corporate world. These collaborative tools—more properly referred to as collaborative *environments*—allow the seamless sharing, consolidation, and tracking of project-relevant data across broadly disparate (and dispersed) organizations, hence making the exchanges faster, more responsive, and orders of magnitude more efficient (all in real-time and in a security-rich environment)[51]. The bottom line is that personal and organizational *productivity* is substantially increased.

We offer that the use of this type of IT tools could bring significant benefits to the processing of CRADAs, not only reducing paperwork and administrative overhead but also *processing time*, which, as we have seen, is a critical problem in the current practice.

5. Organizational Issues

Lastly, we would like to include a few words about organizational issues germane to the NPS case, but which may also be applicable in similar contexts. The significant expansion of technology transfer activity in the School in the last few years has generated a commensurate growth in the workload at the RSPO. For whatever reasons, this *content* expansion was not followed by a corresponding expansion in the organizational structure that was needed to support it.

Long lead times for CRADA negotiations have been aggravated in many instances by a virtual work overflow condition at the RSPO. CRADAs at different stages

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[51] Three interesting examples of these collaborative environments are IBM Lotus Instant Messaging and Web Conferencing (formerly known as *Sametime*), which received the 2004 InfoWorld *"Product of the Year"* award (http://www.lotus.com/products/product3.nsf/wdocs/homepage); the popular Groove Networks Groove Virtual Office (http://www.groove.net/home/index.cfm); and WebEx, which provides a thin browser-based, on-demand audio and video conferencing desktop application (http://www.webex.com/overview/web-conferencing-overview.html).

in the process have ended up in several processing queues—waiting for processing resources to be freed from other work—and hence, considerable backlog has resulted.

Some of the PIs interviewed have been very candid in their remarks concerning process problems and bottlenecks; and they consistently pointed out to this situation as a major concern. PIs do not want to learn about CRADA processing, they want to concentrate—understandably—in their specific technical work. Adequate human resources, with the right skill set and knowledge base need to populate the supporting organizational structures in order to provide the required level of service at the RSPO.

D. SUGGESTIONS FOR FURTHER RESEARCH

From our research, a few areas that might bear further study include:

- CRADAs with non-industry partners, for example other universities and non-profit organizations. From our need to scope and bound our research topic, we focused *only* on industry partnerships. The NPS also conducts a very interesting CRADA program with other universities such as the California State University at Monterey Bay (CSUMB), Mississippi State University, and the Temasek Defence Systems Institute (TDSI) of Singapore. Another domain of CRADA partners includes state, local and other non-profit organizations like the Moss Landing Marine Laboratory, the New Jersey Department of Health and Senior Services and the American Institute of Aeronautics and Astronautics (AIAA). All of these different domains should have their own set of characteristics evaluation criteria and metrics.

- Benchmarking with other institutions. A comparative study of practices and outcomes with other research/educational institutions that possess some of the similar specific attributes that characterize the DoD environment. A particularly interesting case is the Air Force Institute of Technology (AFIT).

- The research and analysis presented in this thesis was focused on the domain of collaborative R&D agreements with non-Federal entities. Although extremely important, this domain is only a small portion of the total research activity conducted at NPS. Unquestionably, the largest research program that is conducted at NPS is

categorized as *sponsored research*, which is also (by our accepted definition) technology transfer, but instead of being *externally* directed—towards non-Federal entities—it is *internally* directed towards DoD sponsors. Effectiveness evaluation criteria and metrics in the area of sponsored research could also provide a very productive field for additional research.

E. FINAL CONCLUSION

This thesis has explored in great detail a very specific mechanism within the broad field of technology transfer: cooperative endeavors for R&D. Evaluation criteria and metrics to determine programmatic success were introduced and supported; later these were used to assess the CRADA program at NPS. Capitalizing on the results obtained from the analysis, a set of recommendations and best practices was suggested. It is the final expectation of the author that this work will be used to increase the understanding of this tremendously critical and complex field, and also to bring about some needed enhancements to the CRADA process. These enhancements will undoubtedly generate even greater benefits from the technology transfer program at NPS for this truly splendid and unique institution and for its current and future industrial partners.

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LIST OF APPENDICES

A. APPENDIX A:

A1: FACULTY (PI) SURVEY QUESTIONNAIRE

A2: INDUSTRY PARTNER SURVEY QUESTIONNAIRE

B. APPENDIX B: SURVEY QUESTIONNAIRE DATA TABLES AND CHARTS

C. APPENDIX C: SUMMARY OF REQUIREMENTS FROM DON LABORATORIES AND/OR TECHNICAL ACTIVITIES TO ENTER INTO CRADAS (FROM SECNAVINST 5700.16A)

D. APPENDIX D: NAVY STANDARD MODEL CRADA

E. NPS TECHNOLOGY TRANSFER BUSINESS PLAN

F. ONR NAVAL TECHNOLOGY NEEDS CODES

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LIST OF REFERENCES

Bennett, J. (1996). Building Relationships for Technology Transfer. *Communications of the ACM*, 39 (9), 35-36.

Booz, Allen and Hamilton (1999). *DoD Cooperative R&D Agreements: Value Added to the Mission*. Retrieved January 20, 2005, from Defense Technical Information Center (DTIC)'s Scientific and Technical Information Network (STINET) database.

Bozeman, B. (2000). Technology Transfer and Public Policy: A Review of Research and Theory. *Research Policy*, 29 (4-5), 627-655. Retrieved January, 27, 2005, from ScienceDirect database.

Coleman, R., & Shelnutt, W. (1995). *Fostering University-Industry Partnerships through Sponsored Undergraduate Design*. Retrieved January 13, 2005, from Frontiers in Education Clearing House Web site: http://fie.engrng.pitt.edu/fie95/2a1/2a12/2a12.htm

Cornell University (2005). *15 USC 3715*. Retrieved May 9, 2005, from Cornell University, Law School Legal Information Institute (LII) Web site: http://www4.law.cornell.edu/uscode/html/uscode15/usc_sec_15_00003715----000-.html

Council on Governmental Relations (COGR) (2000a). *Technology Transfer in U.S. Research Universities: Dispelling Common Myths*. Retrieved January, 10, 2005 from University of Tennessee, Research Foundation Web site: http://utrf.tennessee.edu/tto/docs/TT_myths.pdf

Council on Governmental Relations (COGR) (2000b). *Tutorial on Technology Transfer in U.S. Colleges and Universities*. Retrieved January, 10, 2005 from University of South Carolina, Intellectual Property Office Web site: http://ip.research.sc.edu/PDF/COGR%20TT%20Tutorial%202000.pdf

Department of Defense (DOD) (1999a). *Department of Defense Instruction (DODI) 5535.8 "DoD Technology Transfer (T2) Program"* (Issued: May 14, 1999).

Department of Defense (DOD) (1999b). *Department of Defense Directive (DODD) 5535.3 "DoD Domestic Technology Transfer (T2) Program"* (Issued: May 21, 1999).

Department of Defense (DOD) (2005). *Defense Federal Acquisition Regulations Supplement (DFARS) 227*. Retrieved July 16, 2005, from Federal Acquisition Regulation Site Web site: http://farsite.hill.af.mil/reghtml/regs/far2afmcfars/fardfars/dfars/dfars227.htm

Department of the Navy (DON) (2000). *Secretary of the Navy Instruction (SECNAVINST) 5700.16A "Domestic Technology Transfer (T2)"*. (Issued: March 7, 2000).

Federal Acquisition Regulations (FAR). Reissue 2005. Vol. I and II. Retrieved September 06, 2005, from Federal Acquisition Regulation Homepage: http://www.arnet.gov/far/

Federal Laboratory Consortium for Technology Transfer (FLC) (2002). *Federal Technology Transfer Legislation and Policy*. New Jersey: Universal Technical Resource Services, Inc.

Federal Laboratory Consortium for Technology Transfer (FLC) (2004). *Technology Transfer Desk Reference*. New Jersey: Universal Technical Resource Services, Inc.

Gibson, D., Jarret, J., & Furgeson, J. (1996). Customer Assessment of CRADA Program Performance. *Proceedings of the 29th Annual Hawaii International Conference on System Sciences - 1996*, 232-243. Retrieved January 20, 2005, from IEEE Xplore database.

Groves, N. (2000). *Review of Navy Cooperative Research and Development Agreements (CRADAs) for Fiscal Year 2000*. Virginia: Office of Naval Research.

John, V. (2001). *Department of Defense and Industry: A Healthy Alliance*. Naval Postgraduate School master's thesis. Retrieved January 27, 2005, from Defense Technical Information Center (DTIC)'s Scientific and Technical Information Network (STINET) database.

Kostoff, R. (2005). *Science and Technology Metrics*. Retrieved June 6, 2005, from Office of Naval Research Web site: www.onr.navy.mil/sci_tech/special/354/technowatch/docs/050510_metrics_main_text.pdf

Manning, G. (Ed.). (1974). *Technology Transfer: Successes and Failure*s. San Francisco: San Francisco Press, Inc.

Marshall, C., & Rossman, G. (1999). *Designing Qualitative Research 3rd Edition*. California: SAGE Publications, Inc.

McDonald, J. (1996). *Cooperative Research and Development Agreements (CRADA): Are They Value Added?* Retrieved January 20, 2005, from Defense Technical Information Center (DTIC)'s Scientific and Technical Information Network (STINET) database.

Merriam-Webster's Collegiate Dictionary (2002) - Version 2.5.

Morgen, S. (1993). *Cooperative Research and Development Agreement (CRDA)*. Naval Postgraduate School master's thesis.

Naval Postgraduate School (NPS) (2003a). *Technology Transfer Business Plan*. Retrieved January 10, 2005, from Naval Postgraduate School Web site: http://www.nps.navy.mil/Research/techtran-plan.html

Naval Postgraduate School (NPS) (2003b, June). *Research* Newsletter, 13 (2), June 2003 Retrieved February 4, 2005, from Naval Postgraduate School Web site: http://www.nps.edu/Research/Publications/Newsletters.html

Naval Postgraduate School (NPS) (2004a). *A View to the Future: The Naval Postgraduate School*. Retrieved January 10, 2005, from Naval Postgraduate School Web site: http://www.nps.edu/Aboutnps/QLinks/NPSStratPlan.html

Naval Postgraduate School (NPS) (2004b). *Naval Postgraduate School Fact Book 2004*. Office of Institutional Research.

Naval Postgraduate School (NPS) (2004c). *Sponsored Programs Annual Report. Fiscal Year 2004*. Research and Sponsored Programs Office.

Naval Postgraduate School Foundation, Inc. (NPSFI) (2004). *Transformation Center Business Plan*.

Naval Postgraduate School – Northrop-Grumman Ship Systems (NPS-NGSS) CRADA (2003). *Navy Ship Design*. NCRADA-NPS-03-0051.

Office of Naval Research (ONR) (2002a). *Navy CRADA Handbook*. Retrieved May 16, 2005, from Office of Naval Research, Science and Technology, Industrial and Corporate Programs Web site: http://www.onr.navy.mil/sci_tech/industrial/362/tech_tran/orta/docs/crada_handbook.doc

Office of Naval Research (ONR) (2002b). *Instructions for Use of the 5th Edition, Revision 1, Navy Standard Cooperative Research and Development Agreement (NSCRADA) Template*. Retrieved May 16, 2005, from Office of Naval Research, Science and Technology, Industrial and Corporate Programs Web site: http://www.ih.navy.mil/ttrans/FINAL%20Instructions%20-5th%20Ed%20NSCRADA,%20Rev%201%20dtd%205-1-02.doc

Office of Naval Research (ONR) (2003). *Guidance for Use – Department of the Navy Limited Purpose Cooperative Research and Development Agreement for Equipment or Material Transfer*, 29 August 2003, Enclosure (1). Retrieved May 16, 2005, from Office of Naval Research, Science and Technology, Industrial and Corporate Programs Web site: http://www.onr.navy.mil/sci_tech/industrial/362/tech_tran/docs/guidance_crada.doc\

Office of Naval Research (ONR) (2005a). *CRADA Online Course for the Office of Research and Technology Applications (ORTA)*. Retrieved May 16, 2005, from

Office of Naval Research, Science and Technology, Industrial and Corporate Programs Web site: http://www.onr.navy.mil/sci_tech/industrial/362/training/welcome/topics.asp

Office of Naval Research (ONR) (2005b). *Department of the Navy Technology Transition* (PowerPoint Presentation), ONR available online at http://www.onr.navy.mil/ctto/docs/DoN_TT_MAR_05_Final.ppt

O'Keefe, T. (1982) Evaluation of Technology Transfer: Some Problems and Solutions. *Journal of Technology Transfer*, 6 (2), 53-57.

Punch, K. (1999). *Survey Research: The Basics*. London: SAGE Publications, Inc.

RAND Science and Technology Policy Institute (2003). *Technology Transfer of Federally Funded R&D: Perspectives from a Forum* (Conference Proceedings). Santa Monica: Author.

Rogers, E., Carayannis, E., Kurihara, K., & Allbritton, M. (1998). Cooperative Research and Development Agreements (CRADAs) as Technology Transfer Mechanisms. *R&D Management*, 28 (2), 79–88.

Rogers, E., Yin, J., & Hoffmann, J. (2000). Assessing the Effectiveness of Technology Transfer Offices in U.S Research Universities. *The Journal of the Association of University Technology Managers*, (XII). Retrieved January 20, 2005, from the Association of University Technology Managers (AUTM) Web site: http://www.autm.net/pubs/journal/00/assessing.html

Samli Coskun, A. (Ed.). (1985). *Technology Transfer: Geographic, Economic, Cultural, and Technical Dimensions*. Westport, CT.: Quorum Books.

Siegel, D., Waldman, D. & Link, A. Albert (2000). *Assessing the Impact of Organizational Practices on the Productivity of University Technology Transfer Offices: An Exploratory Study*. Retrieved January 13, 2005, from University of Connecticut, Internet Documents in Economics Access Service (IDEAS) Web site: http://ideas.repec.org/p/nbr/nberwo/7256.html

Stephan, P. (2001). *Educational Implications of University-Industry Technology Transfer*. Retrieved January 13, 2005, from University of Connecticut, Internet Documents in Economics Access Service (IDEAS) Web site: http://ideas.repec.org/a/kap/jtecht/v26y2001i3p199-205.html

The Carnegie Foundation for the Advancement of Teaching (2000). *The Carnegie Classification of Institutions of Higher Education*. Retrieved June 6, 2005, from Carnegie Foundation for the Advancement of Teaching Web site: http://www.carnegiefoundation.org/Classification/

Trotta Associates, Inc. (2003). *Assessment of Industry Attitudes on Collaborating with the U.S. Department of Defense in Research and Development and Technology Sharing*. Retrieved May 2, 2005, from Defense Technical Information Center (DTIC)'s Scientific and Technical Information Network (STINET) database.

Vincent, D. (2004). *Review of Navy Cooperative Research and Development Agreements (CRADAs) for Fiscal Year 2004*. Virginia: Office of Naval Research.

Williams, K. (2002). *Creating Partnerships with Power*. Retrieved March 10, 2005 from Environmental Design & Construction Web site: http://www.edcmag.com/CDA/ArticleInformation/features/BNP__Features__Item/0,4120,75531,00.html

APPENDIX A Questionnaire Samples

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A1 - FACULTY QUESTIONNAIRE

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Cooperative Research and Development Agreements Faculty Questionnaire

(This questionnaire is part of an NPS student thesis research)

CRADA	
RSPO Designator	
Principal Investigator	
Industry Partner	

INSTRUCTIONS: Please complete all questions, then save using the same filename as originally received and submit via e-mail to gferrari@nps.edu

(1) Check boxes allow multiple selections.
(2) Radio buttons allow a single selection among alternatives.
(3) Text boxes are of unlimited length.

In order to fill out this electronic form "macros" need to be allowed to run. See introductory e-mail for details on setting your macro permissions in Microsoft Word.

CRADA Background

1. Where did the initial demand for this cooperative research originate?

   ☐ NPS demand

   ☐ Industry demand

2. How was the CRADA initiated? Were you part of that process?

3. Why was the CRADA mechanism selected?

Objectives

4. Were there specific research/academic benefits for the School established as objectives for this CRADA? If so, please elaborate.

☐ Yes ☐ No

5. To what extent were these objectives met? If necessary, please add any comments below.

Fully Met	Partially Met (High Percentage)	Partially Met (Low Percentage)	Not Met At All	No Such Objectives
☐	☐	☐	☐	☐

6. If the CRADA had not been established, would these objectives have been met in any other way? How (please elaborate)?

7. Were all tasks in the "Statement of Work" satisfactorily completed? If not, please elaborate in the space provided below.

a. NPS tasks

Totally Completed	Partially Completed (High Percentage)	Partially Completed (Low Percentage)	Not Completed At All	No Such Tasks Defined
☐	☐	☐	☐	☐

b. Industry Partner tasks

Totally Completed	Partially Completed (High Percentage)	Partially Completed (Low Percentage)	Not Completed At All	No Such Tasks Defined
☐	☐	☐	☐	☐

c. Joint tasks

Totally Completed	Partially Completed (High Percentage)	Partially Completed (Low Percentage)	Not Completed At All	No Such Tasks Defined
☐	☐	☐	☐	☐

8. Check (if applicable) any of the following potential benefits for the School that were realized through this CRADA:

- ☐ Access to expertise not available within the School.
- ☐ Access to technology and tools not available within the School.
- ☐ Access to industry data.
- ☐ Access to industry generated research.
- ☐ Contractor support for project related work (manpower).
- ☐ Funding (travel, equipment, etc.).
- ☐ Industry exchanges.
- ☐ Others (please elaborate in the space provided below).

9. Was the CRADA sufficient to meet the research needs that it was applied to? If not, in what ways was it insufficient?

☐ Yes ☐ No

10. Did the CRADA result in any of the following student related work?

- ☐ Course projects.
- ☐ Theses.
- ☐ Other (please elaborate in the space provided below).

11. Did the CRADA result in updates to a curriculum or initiation of a new curriculum or academic program? If so, please elaborate.

☐ Yes ☐ No

CRADA Process and other Specific Issues

12. Was a final report generated for the CRADA?

☐ Yes ☐ No

13. Was the CRADA mechanism effective with regards to the following criteria?

a. Management of communications between NPS and the industry partner.

Very Effective	Effective	Neutral	Ineffective	Very Ineffective
☐	☐	☐	☐	☐

b. Management and supervision of objectives, tasking and performance.

Very Effective	Effective	Neutral	Ineffective	Very Ineffective
☐	☐	☐	☐	☐

c. Management and supervision of resources.

Very Effective	Effective	Neutral	Ineffective	Very Ineffective
☐	☐	☐	☐	☐

14. Did "Intellectual Property" issues generate conflict during the drafting, negotiation or execution phases of the CRADA? If so, please elaborate.

☐ Yes ☐ No

15. Rate your satisfaction with the work performed/support received from the Research and Sponsored Programs Office (RSPO) staff during the preparation, negotiations and establishment of the CRADA.

Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
☐	☐	☐	☐	☐

16. Have you observed any negative repercussions related to the CRADA? If so, please elaborate?

☐ Yes ☐ No

17. How would the following measures contribute to enhancing the CRADA process?

a. Simplifying/reducing the administrative-bureaucratic steps required to set up the agreement.

Extremely Useful	Very Useful	Useful	Marginally Useful	Not Useful
☐	☐	☐	☐	☐

b. Reducing the time required to set up the agreement.

Extremely Useful	Very Useful	Useful	Marginally Useful	Not Useful
☐	☐	☐	☐	☐

c. Increasing the use of collaborative tools (Information Technology).

Extremely Useful	Very Useful	Useful	Marginally Useful	Not Useful
☐	☐	☐	☐	☐

d. Increasing faculty and staff training in Technology Transfer related activities.

Extremely Useful	Very Useful	Useful	Marginally Useful	Not Useful
☐	☐	☐	☐	☐

18. Can you suggest additional ways in which the process can be enhanced or improved?

19. Can you suggest specific tools which could be used to enhance or improve the process?

20. How would the following measures contribute to obtaining better results from the cooperative research program/activities at NPS?

a. Increasing industry awareness of specific opportunities for cooperative research at NPS.

Extremely Useful	Very Useful	Useful	Marginally Useful	Not Useful
☐	☐	☐	☐	☐

b. Promoting additional mechanisms to build a trusted relationship with industry (work for service, industry exchanges of faculty/students, consortia, etc.).

Extremely Useful	Very Useful	Useful	Marginally Useful	Not Useful
☐	☐	☐	☐	☐

c. Generating additional incentives for faculty to participate in Technology Transfer activities (i.e. promotion and tenure requirements).

Extremely Useful	Very Useful	Useful	Marginally Useful	Not Useful
☐	☐	☐	☐	☐

d. Improving the connection between CRADA research objectives and the research funding process.

Extremely Useful	Very Useful	Useful	Marginally Useful	Not Useful
☐	☐	☐	☐	☐

e. Improving the dissemination of CRADA results (in industry, School, third parties, etc.).

Extremely Useful	Very Useful	Useful	Marginally Useful	Not Useful
☐	☐	☐	☐	☐

f. Others. Please elaborate.

21. Any other comments related to “Technology Transfer” or Industry-Academia partnerships?

22. Any other remarks or additional comments?

23. Can you provide contact information of an “industry counterpart” for this CRADA who could be reached to answer a similar “industry partner” questionnaire?

End of the questionnaire. Thank you for your time and contribution to this research.

A2 - INDUSTRY QUESTIONNAIRE

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Cooperative Research and Development Agreements Industry Questionnaire

(This questionnaire is part of an NPS student thesis research)

CRADA	
RSPO Designator	
Principal Investigator	
Industry Partner	

INSTRUCTIONS: **Please complete all questions, then save using the same filename as originally received and submit via e-mail to gferrari@nps.edu**

(1) Check boxes allow multiple selections.
(2) Radio buttons allow single selection among alternatives.
(3) Text boxes are of unlimited length.

CRADA Background

1. How was the CRADA initiated? Were you part of that process?

2. Why was the Naval Postgraduate School (NPS) selected as partner for this CRADA?

3. How did you become aware of the capabilities (related to the CRADA) that were available at the NPS?

4. Why was the CRADA mechanism selected?

Objectives

5. Were there specific benefits for your company established as objectives for this CRADA? If so, please elaborate.

☐ Yes ☐ No

6. To what extent were these objectives met? If necessary, please add any comments below.

Fully Met	Partially Met (High Percentage)	Partially Met (Low Percentage)	Not Met At All	No Such Objectives
☐	☐	☐	☐	☐

7. If the CRADA with NPS had not been established, would these objectives have been met in any other way? How (please elaborate)?

8. Were all tasks in the "Statement of Work" satisfactorily completed? If not, please elaborate in the space provided below.

a. NPS tasks

Totally Completed	Partially Completed (High Percentage)	Partially Completed (Low Percentage)	Not Completed At All	No Such Tasks Defined
☐	☐	☐	☐	☐

b. Industry Partner tasks

Totally Completed	Partially Completed (High Percentage)	Partially Completed (Low Percentage)	Not Completed At All	No Such Tasks Defined
☐	☐	☐	☐	☐

c. Joint tasks

Totally Completed	Partially Completed (High Percentage)	Partially Completed (Low Percentage)	Not Completed At All	No Such Tasks Defined
☐	☐	☐	☐	☐

9. Check (if applicable) any of the following potential benefits for your company that were realized through this CRADA:

- ☐ Access to specific operational expertise (military domain).
- ☐ Access to technical expertise not available within your company.
- ☐ Access to technology and tools not available within your company.
- ☐ Access to testing facilities and equipment not available within your company.
- ☐ Access to Navy/DoD data.
- ☐ Access to Navy/DoD generated research.
- ☐ Access to information regarding Navy/DoD needs and opportunities.
- ☐ Leverage of internal R&D resources through collaborative research.
- ☐ Reduced development cycle/time to market for specific products or services.
- ☐ Others (please elaborate in the space provided below).

10. Did the CRADA specifically result in any of the following?

- ☐ New or improved commercial products, services or processes.
- ☐ New capabilities yielding a competitive advantage non existent before the CRADA.
- ☐ Patents or any other intellectual property rights on CRADA related data.
- ☐ Support for SBIR/STTR program(s).
- ☐ Follow-on contracts with the Navy/DoD.
- ☐ Other (please elaborate in the space provided below).

11. Was the CRADA sufficient to meet the needs that it was applied to? If not, in what ways was it insufficient?

☐ Yes ☐ No

CRADA Process and other Specific Issues

12. Was a final report internally or jointly generated for the CRADA?

☐ Yes ☐ No

13. Was the CRADA mechanism effective with regards to the following criteria?

a. Management of communications between NPS and your company.

Very Effective	Effective	Neutral	Ineffective	Very Ineffective
☐	☐	☐	☐	☐

b. Management and supervision of objectives, tasking and performance.

Very Effective	Effective	Neutral	Ineffective	Very Ineffective
☐	☐	☐	☐	☐

c. Management and supervision of resources.

Very Effective	Effective	Neutral	Ineffective	Very Ineffective
☐	☐	☐	☐	☐

14. Did “Intellectual Property” issues generate conflict during the drafting, negotiation or execution phases of the CRADA? If so, please elaborate.

☐ Yes ☐ No

15. Rate your satisfaction with the work performed/support received from the NPS Research and Sponsored Programs Office (RSPO) staff during the preparation, negotiations and establishment of the CRADA.

Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
☐	☐	☐	☐	☐

16. Have you observed any negative repercussions related to this CRADA with NPS? If so, please elaborate?

☐ Yes ☐ No

17. How would the following measures contribute to enhancing the CRADA process?

a. Simplifying/reducing the <u>administrative-bureaucratic steps</u> required to set up the agreement.

Extremely Useful	Very Useful	Useful	Marginally Useful	Not Useful
☐	☐	☐	☐	☐

b. Reducing the time required to set up the agreement.

Extremely Useful	Very Useful	Useful	Marginally Useful	Not Useful
☐	☐	☐	☐	☐

c. Increasing the use of collaborative tools (Information Technology).

Extremely Useful	Very Useful	Useful	Marginally Useful	Not Useful
☐	☐	☐	☐	☐

d. Increasing participants' training in Technology Transfer related activities.

Extremely Useful	Very Useful	Useful	Marginally Useful	Not Useful
☐	☐	☐	☐	☐

18. Can you suggest additional ways in which the process can be enhanced or improved?

19. Can you suggest specific tools which could be used to enhance or improve the process?

20. How would the following measures contribute to obtaining better results from the cooperative research program/activities with NPS?

a. Increasing industry awareness of specific opportunities for cooperative research at NPS.

Extremely Useful	Very Useful	Useful	Marginally Useful	Not Useful
☐	☐	☐	☐	☐

b. Promoting additional mechanisms to build a trusted relationship with NPS (work for service, industry exchanges of faculty/students, consortia, etc.).

Extremely Useful	Very Useful	Useful	Marginally Useful	Not Useful
☐	☐	☐	☐	☐

c. Generating additional incentives for industry to participate in collaborative technology transfer activities. If useful, please provide examples in the space provided below.

Extremely Useful	Very Useful	Useful	Marginally Useful	Not Useful
☐	☐	☐	☐	☐

d. Improving the connection between CRADA research objectives and the research funding process.

Extremely Useful	Very Useful	Useful	Marginally Useful	Not Useful
☐	☐	☐	☐	☐

e. Improving the dissemination of CRADA results (in industry, School, third parties, etc.).

Extremely Useful	Very Useful	Useful	Marginally Useful	Not Useful
☐	☐	☐	☐	☐

f. Others. Please elaborate.

21. Any other comments related to “Technology Transfer” or Industry-Academia partnerships?

22. Any other remarks or additional comments?

End of the questionnaire. Thank you for your time and contribution to this research.

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APPENDIX B

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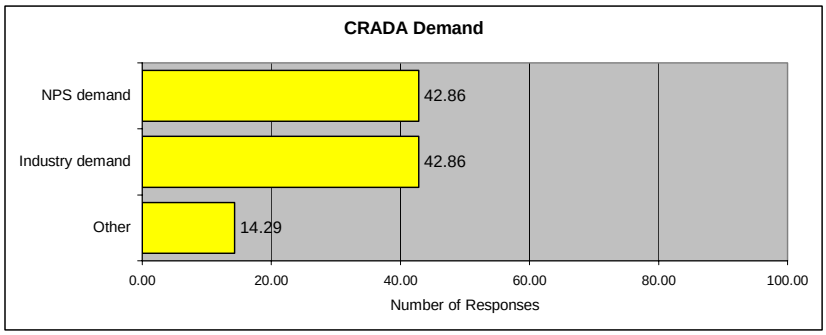
FACULTY SURVEY DATA (1)

CRADA Background

1. Where did the initial demand for this cooperative research [CRADA] originate?

	CRADA Survey Number																					Resp	%
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
NPS demand	x		x		x	x			x	x			x		x	x								9	42.86
Industry demand		x		x							x	x		x			x	x	x		x			9	42.86
Other							x	x												x				3	14.29

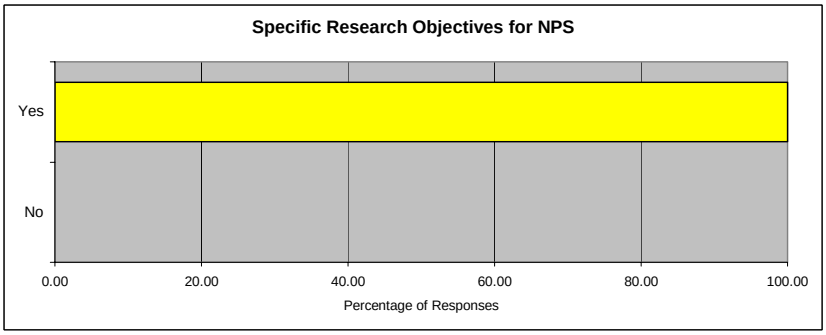
Other: (3) Not clearly defined; mutual interest through informal discussions.



CRADA Objectives

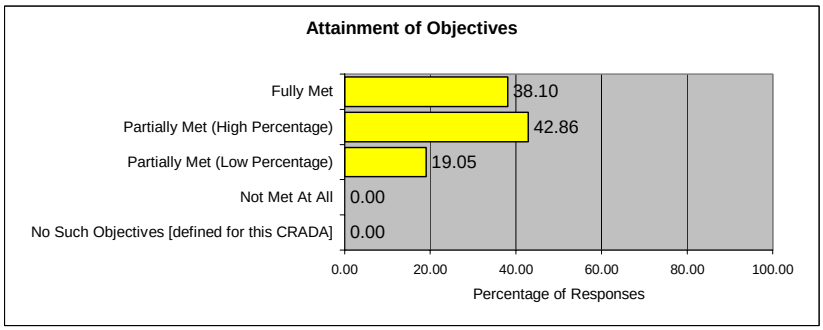
4. Were there specific research/academic benefits for the School established as objectives for this CRADA?

																						Resp	%
Yes	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	21	100.00
No																						0	0.00



5. To what extent were these [research/academic] objectives met?

																						Resp	%
Fully Met	x	x			x	x			x	x							x			x		8	38.10
Partially Met (High Percentage)			x	x			x	x			x	x	x	x	x							9	42.86
Partially Met (Low Percentage)																	x	x		x	x	4	19.05
Not Met At All																						0	0.00
No Such Objectives [defined for this CRADA]																						0	0.00
C: Closed CRADA - A: Active CRADA	C	C	C	C	A	A	A	C	A	A	C	A	C	C	A	A	C	C	C	C	C		



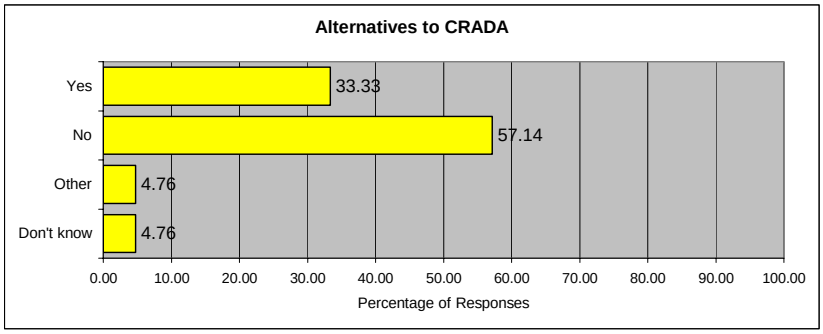
FACULTY SURVEY DATA (2)

	CRADA Survey Number																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Resp	%

6. If the CRADA had not been established, would these objectives have been met in any other way?

Yes	x						x	x		x	x						x			x				7	33.33
No		x	x	x		x			x			x	x		x	x		x	x		x			12	57.14
Other					x																			1	4.76
Don't know														x										1	4.76

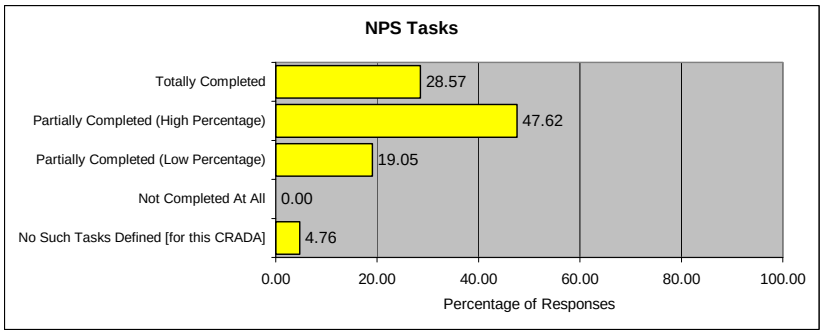
Other:
(3) Yes, but it would have taken longer to achieve same results
(1) Yes, but not same level of attainment
(2) Yes, look for other sources of funding



7. Were all tasks in the SOW satisfactorily completed?

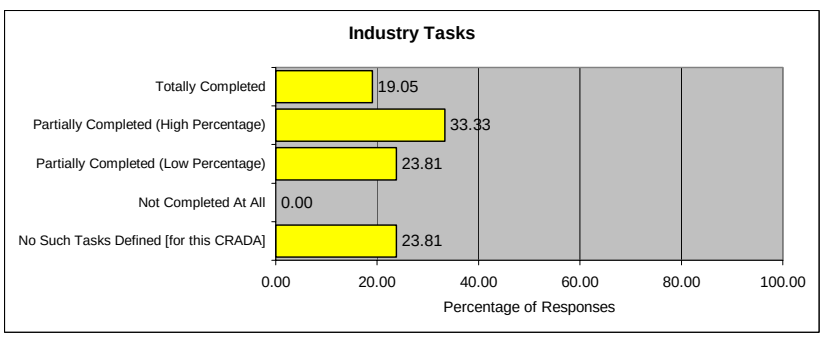
7a. NPS tasks

Totally Completed	x	x					x	x	x	x														6	28.57
Partially Completed (High Percentage)			x	x	x	x					x	x	x	x	x	x								10	47.62
Partially Completed (Low Percentage)																	x	x		x	x			4	19.05
Not Completed At All																								0	0.00
No Such Tasks Defined [for this CRADA]																			x					1	4.76
C: Closed CRADA - A: Active CRADA	C	C	C	C	A	A	A	C	A	A	C	A	C	C	A	A	C	C	C	C	C				



7b. Industry Partner tasks

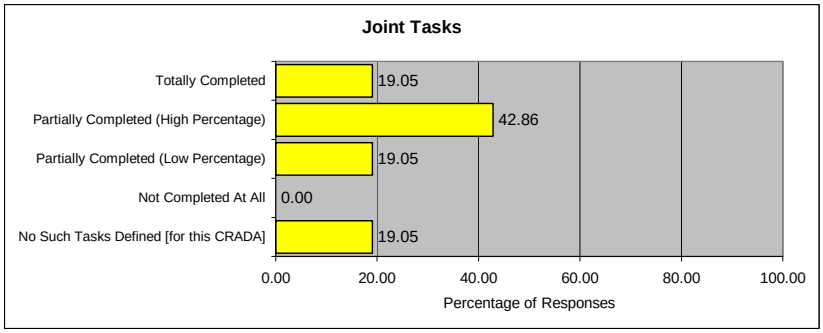
Totally Completed	x	x							x	x														4	19.05
Partially Completed (High Percentage)					x	x					x	x	x	x		x								7	33.33
Partially Completed (Low Percentage)															x		x	x		x	x			5	23.81
Not Completed At All																								0	0.00
No Such Tasks Defined [for this CRADA]			x	x			x	x											x					5	23.81
C: Closed CRADA - A: Active CRADA	C	C	C	C	A	A	A	C	A	A	C	A	C	C	A	A	C	C	C	C	C				



FACULTY SURVEY DATA (3)

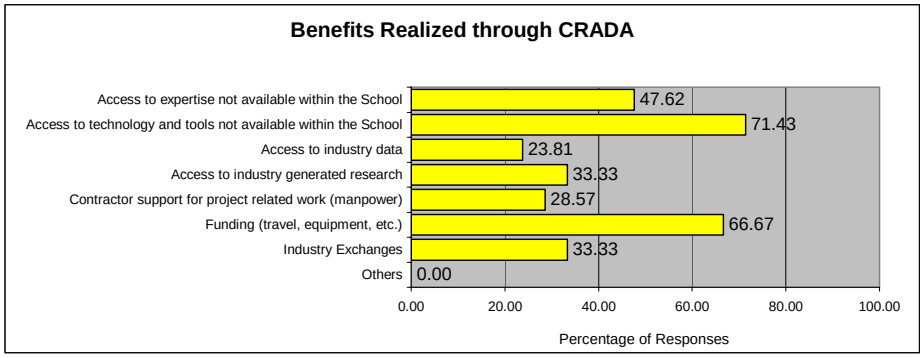
7c. Joint tasks

	CRADA Survey Number																					Resp	%
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
Totally Completed	x								x	x									x					4	19.05
Partially Completed (High Percentage)		x			x	x					x	x	x	x	x	x								9	42.86
Partially Completed (Low Percentage)																	x	x		x	x			4	19.05
Not Completed At All																								0	0.00
No Such Tasks Defined [for this CRADA]			x	x			x	x																4	19.05
C: Closed CRADA - A: Active CRADA	C	C	C	C	A	A	A	C	A	A	C	A	C	C	A	A	C	C	C	C					



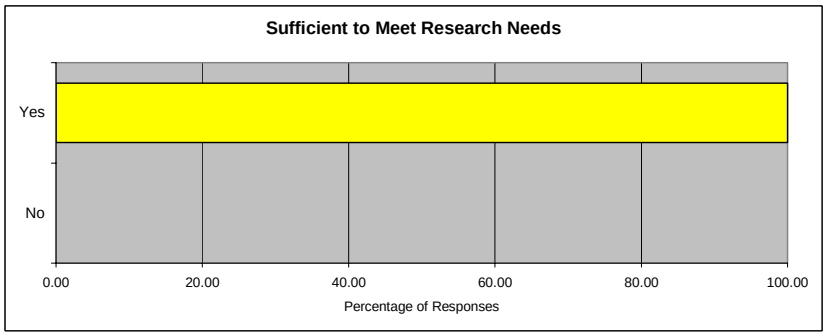
8. Benefits from CRADA

																						Resp	%
Access to expertise not available within the School	x				x			x		x				x		x	x	x	x		x	10	47.62
Access to technology and tools not available within the School		x	x	x		x	x	x	x	x					x	x	x	x	x	x	x	15	71.43
Access to industry data		x									x		x		x			x				5	23.81
Access to industry generated research								x		x						x	x	x	x		x	7	33.33
Contractor support for project related work (manpower)	x									x					x		x	x			x	6	28.57
Funding (travel, equipment, etc.)		x	x				x	x	x	x	x	x		x			x	x	x	x	x	14	66.67
Industry Exchanges									x	x			x	x			x	x			x	7	33.33
Others																						0	0.00



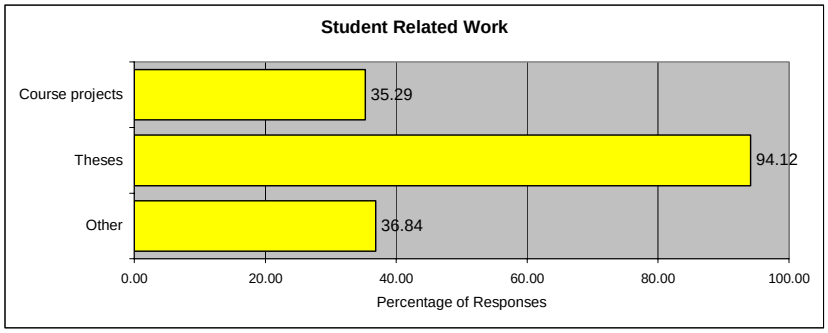
9. Was the CRADA sufficient to meet the research needs that it was applied to?

																						Resp	%
Yes	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	21	100.00
No																						0	0.00



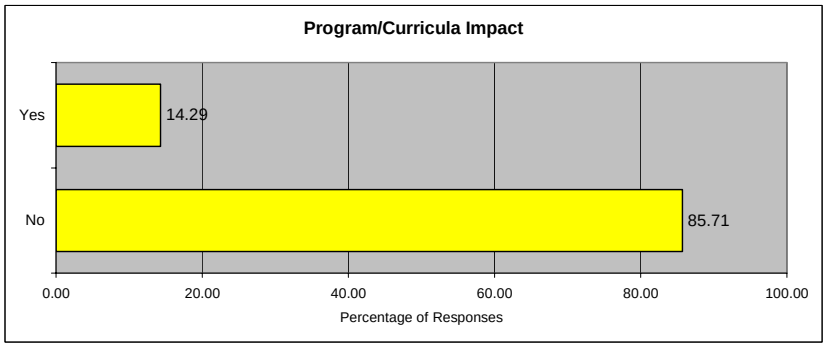
FACULTY SURVEY DATA (4)

	CRADA Survey Number																							Resp	%
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
10. Student Related Work																									
Course projects							x	x				x			x		x		x					6	35.29
Theses		x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x						16	94.12
Other																								7	36.84
	N												N							N	N			4	19.05



11. Did the CRADA result in updates to a curriculum or initiation of a new curriculum or academic program?

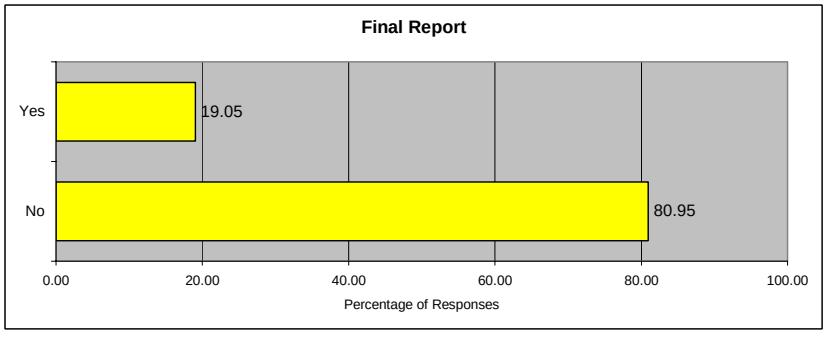
Yes								x		x		x												3	14.29
No	x	x	x	x	x	x	x		x		x		x	x	x	x	x	x	x	x	x			18	85.71



CRADA Process and Other Issues

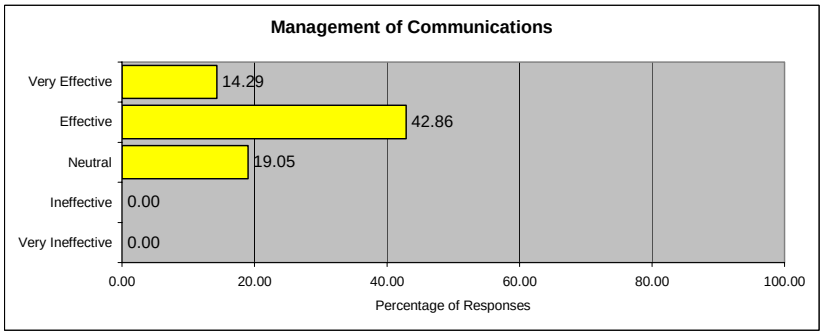
12. Was a final report generated for the CRADA?

Yes	x	x							x					x										4	19.05
No			x	x	x	x	x	x		x	x	x	x		x	x	x	x	x	x	x			17	80.95
C: Closed CRADA - A: Active CRADA	C	C	C	C	A	A	A	C	A	A	C	A	C	C	A	A	C	C	C	C					

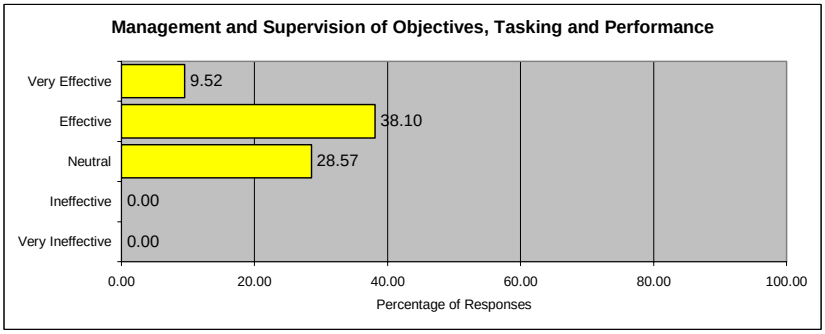


FACULTY SURVEY DATA (5)

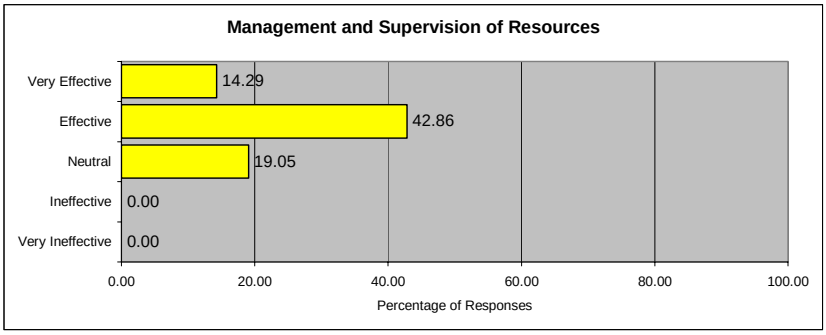
	CRADA Survey Number																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Resp	%
13. Was the CRADA mechanism effective with regards to the the following criteria?																									
13a. Management of communications between NPS and the industry partner.																									
Very Effective	x									x									x					3	14.29
Effective		x					x	x				x	x	x	x			x	x					9	42.86
Neutral									x		x					x							x	4	19.05
Ineffective																								0	0.00
Very Ineffective																								0	0.00
					N/A																NR				



13b. Management and supervision of objectives, tasking and performance.																									
Very Effective	x									x														2	9.52
Effective		x					x	x				x	x	x				x	x					8	38.10
Neutral									x		x					x	x			x			x	6	28.57
Ineffective																								0	0.00
Very Ineffective																								0	0.00

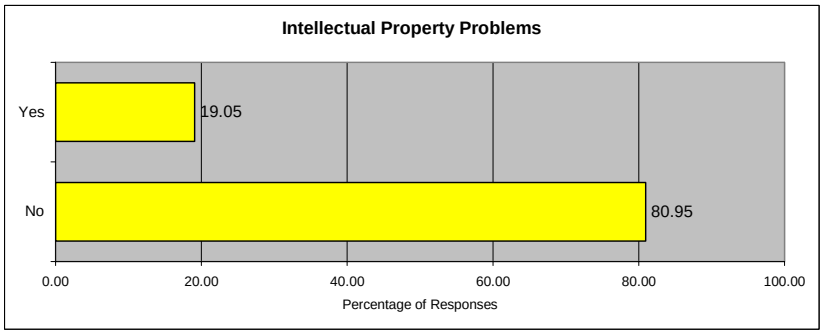


13c. Management and supervision of resources?																									
Very Effective	x									x				x										3	14.29
Effective		x					x	x				x	x		x			x	x					9	42.86
Neutral									x		x					x				x			x	4	19.05
Ineffective																								0	0.00
Very Ineffective																								0	0.00

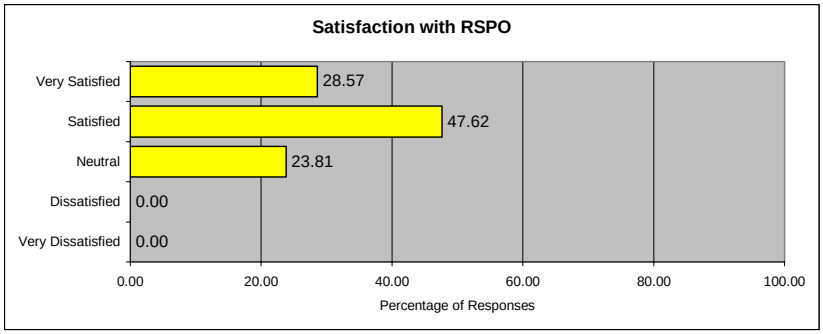


FACULTY SURVEY DATA (6)

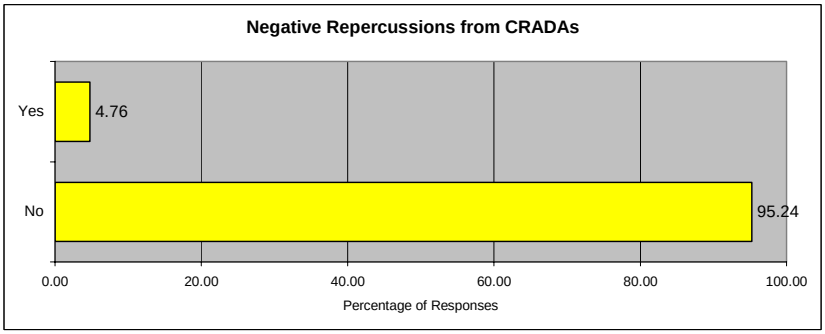
	CRADA Survey Number																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Resp	%
14. Did "Intellectual Property" issues generate conflict during the drafting, negotiation or execution phases of the CRADA?																									
Yes				x										x					x	x				4	19.05
No	x	x	x		x	x	x	x	x	x	x	x	x		x	x	x	x			x			17	80.95



15. Rate your satisfaction with the work performed/support received from the RSPO staff during the preparation, negotiations and establishment of the CRADA.																								
Very Satisfied	x	x					x	x							x						x			6	28.57
Satisfied					x	x			x	x			x	x		x	x	x		x				10	47.62
Neutral			x	x							x	x							x					5	23.81
Dissatisfied																								0	0.00
Very Dissatisfied																								0	0.00

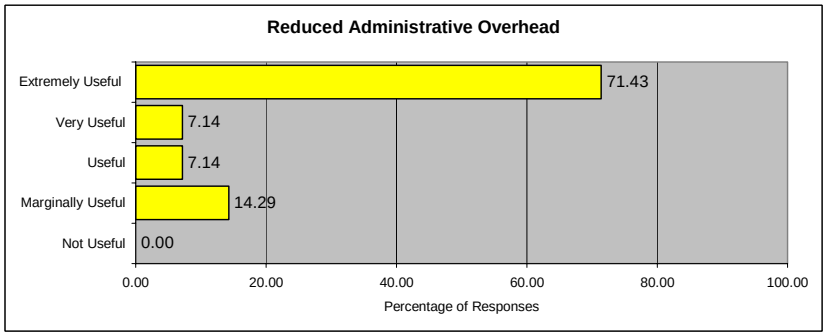


16. Have you observed any negative repercussions related to the CRADA?																								
Yes																				x				1	4.76
No	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x			20	95.24

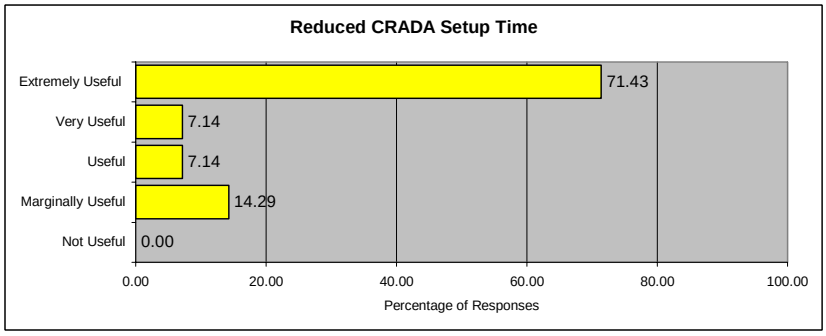


FACULTY SURVEY DATA (7)

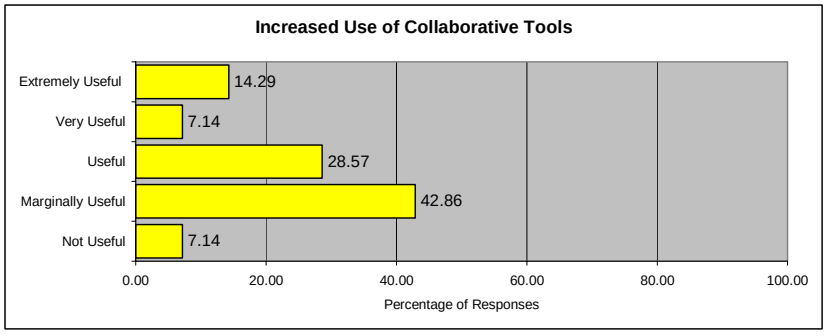
	CRADA Survey Number																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Resp	%
17. How would the following measures contribute to enhancing the CRADA process?																									
17a. Simplifying/reducing the administrative-bureaucratic steps required to set up the agreement.																									
Extremely Useful		x	x	x	x	x			x	x	x	x	x	x		x	x	x	x					10	71.43
Very Useful							x	x																1	7.14
Useful	x																							1	7.14
Marginally Useful															x						x			2	14.29
Not Useful																								0	0.00
Colored: same PI																				NR					



17b. Reducing the time required to set up the agreement.																									
Extremely Useful		x	x	x	x	x			x	x	x	x	x	x		x	x	x	x					10	71.43
Very Useful							x	x																1	7.14
Useful	x																							1	7.14
Marginally Useful															x						x			2	14.29
Not Useful																								0	0.00
Colored: same PI																				NR					



17c. Increasing the use of collaborative tools (Information Technology).																									
Extremely Useful		x										x												2	14.29
Very Useful										x														1	7.14
Useful	x										x	x		x	x									4	28.57
Marginally Useful			x	x	x	x	x	x	x								x	x	x		x			6	42.86
Not Useful																x								1	7.14
Colored: same PI																				NR					

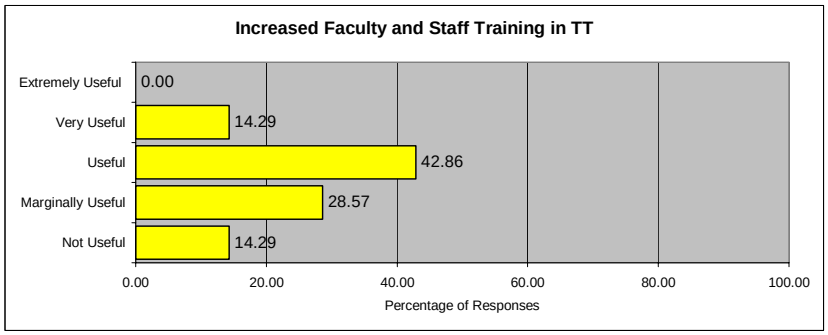


FACULTY SURVEY DATA (8)

17d. Increasing faculty and staff training in Technology Transfer related activities.

	CRADA Survey Number																					Resp	%
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
Extremely Useful																								0	0.00
Very Useful	x									x														2	14.29
Useful		x	x	x	x	x					x	x		x			x	x	x					6	42.86
Marginally Useful													x		x	x					x			4	28.57
Not Useful							x	x	x															2	14.29

Colored: same PI NR



20. How would the following measures contribute to obtaining better results from the cooperative research program/activities at NPS?
20a. Increasing industry awareness of specific opportunities for cooperative research at NPS.

Extremely Useful										x														1	7.14
Very Useful	x	x											x	x			x	x	x		x			7	50.00
Useful			x	x	x	x	x	x	x		x	x												4	28.57
Marginally Useful																x								1	7.14
Not Useful																	x							1	7.14

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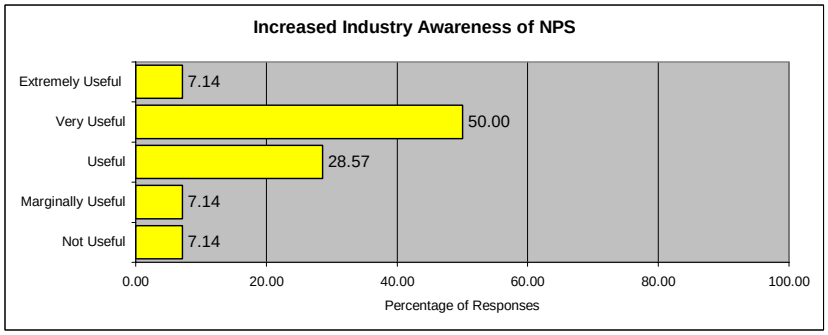

20b. Promoting additional mechanisms to build a trusted relationship with industry (work for service, industry exchanges of faculty/students, consortia, etc.).

Extremely Useful										x				x		x								3	21.43
Very Useful	x						x	x					x								x			4	28.57
Useful		x									x	x			x		x	x	x					5	35.71
Marginally Useful			x	x	x	x			x															2	14.29
Not Useful																								0	0.00

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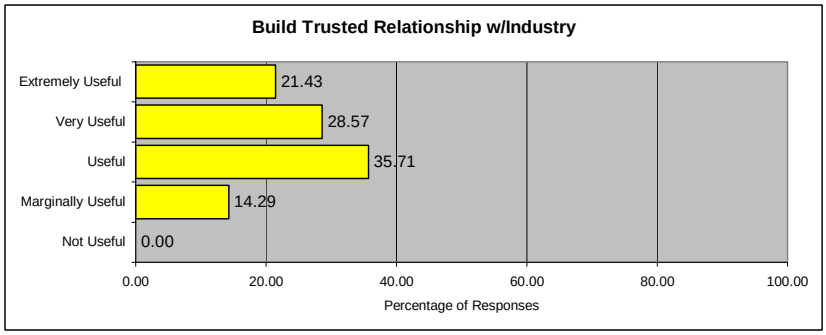

FACULTY SURVEY DATA (9)

	CRADA Survey Number																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Resp	%
20c. Generating additional incentives for faculty to participate in Technology Transfer activities (i.e. promotion and tenure requirements).																									
Extremely Useful													x	x										2	14.29
Very Useful											x	x					x	x	x					3	21.43
Useful		x							x	x					x									4	28.57
Marginally Useful	x		x	x	x	x										x					x			4	28.57
Not Useful							x	x																1	7.14
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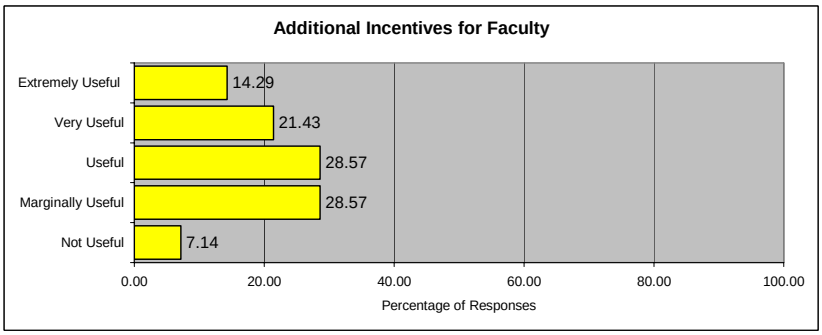
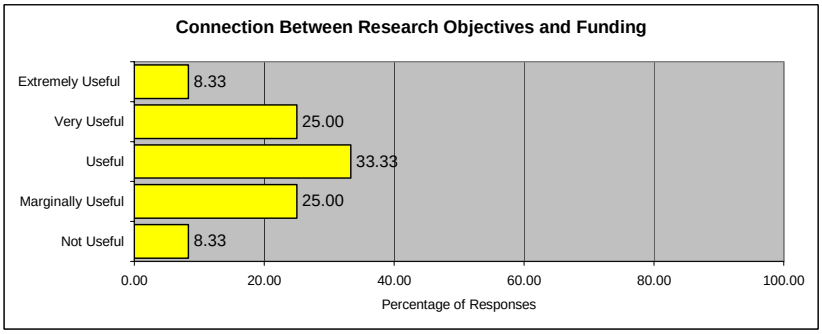
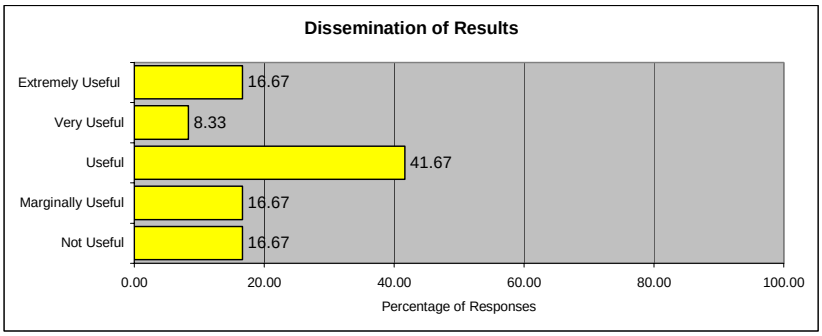


	CRADA Survey Number																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Resp	%
20d. Improving the connection between CRADA research objectives and the research funding process.																									
Extremely Useful										x														1	8.33
Very Useful		x											x	x										3	25.00
Useful	x										x	x					x	x	x					4	33.33
Marginally Useful									x						x						x			3	25.00
Not Useful			x	x	x	x																		1	8.33
Colored: same PI																									



	CRADA Survey Number																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Resp	%
20e. Improving the dissemination of CRADA results (in industry, School, third parties, etc.).																									
Extremely Useful	x						x	x																2	16.67
Very Useful																		x	x					1	8.33
Useful		x								x	x	x		x							x			5	41.67
Marginally Useful													x		x									2	16.67
Not Useful			x	x	x	x			x															2	16.67
Colored: same PI																NR	NR				NR				



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APPENDIX C

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Summary of Provisions Required from DoN Laboratories and/or Technical Activities to Enter Into a CRADA (From SECNAVINST 5700.16A)

All DoN laboratories and/or technical activities are delegated the authority to enter into CRADAs, including technical assistance and military-use CRADAs, and licenses of Navy inventions provided that:

1. The following qualifications are met:

    - Procedures are established for entering into CRADAs and patent licenses.

    - Personnel with training or experience in technology transfer are designated to be responsible for implementing the procedures.

    - A single point of contact for interface with the Office of Naval Research (ONR) is sent to ONR.

    - Personnel responsible for implementing the procedures receive at least eight hours of training in technology transfer every year.

2. Legal review is obtained prior to entering into an agreement to ensure that the CRADA or license conforms to all statutes, regulations, Executive Orders, and binding instructions issued within DoD.

3. Reports and executed copies of CRADAs and licenses are submitted as directed by ONR per 15 U.S.C sections 3702, 3703, 3705, 3706, 3710, 3712, and 3715.

4. A CRADA or license normally conforms to Navy policy. If a deviation from Navy policy is deemed warranted by unusual circumstances, a written explanation of the reasons for the deviation is prepared and legal review is obtained prior to entering into the CRADA or license. A copy of the written explanation and legal review is attached to the copy of the CRADA or license that is sent to ONR.

5. Review and approval are obtained from the United States Trade Representative for all CRADAs and licenses with foreign persons or industrial organizations that are directly or indirectly controlled by a foreign company or government per Executive Order 12591, “Facilitating Access to Science and Technology, April 10, 1996.

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APPENDIX D

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STANDARD

NAVY COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENT

BETWEEN

NAVAL POSTGRADUATE SCHOOL

AND

[NON-NAVY COLLABORATOR]

AGREEMENT TITLE:

AGREEMENT NUMBER: NCRADA-[Navy Org.] – [last two digits of CY] – [serial number]

AGREEMENT ADMINISTRATORS:

NAVAL POSTGRADUATE SCHOOL

Technology Transfer Office:

Legal Counsel:

Principal Investigator: [insert name, organization code, telephone number]

[NON-NAVY COLLABORATOR]

Preferred Contact: [insert name, telephone number]

Legal Counsel [OPTIONAL]: [insert name, telephone number]

Principal Investigator: [insert name, telephone number]

TABLE OF CONTENTS

PREAMBLE

Article 1. DEFINITIONS

1.1 “Agreement”
1.2 “Classified Information”
1.3 “Collaborator”
1.4 “Controlled Unclassified Information (CUI)”
1.5 “Cooperative Work”
1.6 “Data”
1.7 “Effective Date”
1.8 “Exclusive License”
1.9 “Government”
1.10 “Government Purpose Rights”
1.11 “Information”
1.12 “Intellectual Property”
1.13 “Invention”
1.14 “Invention Disclosure”
1.15 “Made”
1.16 “Militarily Critical Technologies (MCT)”
1.17 “Non-Subject Data”
1.18 “Non-Subject Invention”
1.19 “Patent Application”
1.20 “Principal Investigator (PI)”
1.21 “Proprietary Information”
1.22 “Restricted Access Information”
1.23 “Subject Data”
1.24 “Subject Invention”
1.25 “Tangible Property”
1.26 “Unlimited Rights”

Article 2. OBJECTIVES

Article 3. RESPONSIBILITIES

3.1 **NPS** Personnel and Facilities
3.2 **[Non-Navy Collaborator]** Personnel and Facilities
3.3 Security Regulations and Directives

Article 4. REPRESENTATIONS AND WARRANTIES

4.1 **NPS**’s Representations and Warranties
4.2 **[Non-Navy Collaborator]**’s Representations and Warranties
4.3 Joint Representations

Article 5. FUNDING

5.1 Payment Schedule
5.2 Insufficient and Excess Funds
5.3 No New Commitments
5.4 Accounting Records

Article 6. REPORTS AND PUBLICATIONS

6.1 Interim Reports
6.2 Final Reports
6.3 Agreement to Confer Prior to Publication or Public Disclosure
6.4 Classified Information

Article 7. INTELLECTUAL PROPERTY

7.1 Data
- 7.1.1 General Provisions Applying to All Data
  - 7.1.1.1 Ownership
  - 7.1.1.2 No Implied License
  - 7.1.1.3 Marking of Data
    - 7.1.1.3.1 Data Provided With Less Than Unlimited Rights
    - 7.1.1.3.2 Data That are Proprietary Information or Restricted Access Information
    - 7.1.1.3.3 Data That are Subject to 35 USC 205
    - 7.1.1.3.4 Data That are Classified Information, CUI, MCT, or Otherwise Restricted
  - 7.1.1.4 Protection of Data
  - 7.1.1.5 Release of Data Under the Freedom of Information Act
- 7.1.2 Subject Data
  - 7.1.2.1 Delivery of Requested Subject Data
  - 7.1.2.2 Rights in Subject Data
- 7.1.3 Rights in Non-Subject Data

7.2 Copyrights
- 7.2.1 Copyright by **[Non-Navy Collaborator]**
- 7.2.2 Copyright License to the Government
- 7.2.3 Copyright Statement

7.3 Trademarks and Service Marks
- 7.3.1 Ownership of Trademarks and Service Marks
- 7.3.2 Obligation of Employees to Report Trademarks and Service Marks
- 7.3.3 Obligation of Collaborators to Notify Each Other

7.3.4 Responsibility for Filing an Application for Trademark or Service Mark
7.3.5 License to Use Trademark or Service Mark
7.4 Subject Inventions
7.4.1 Obligation to Report Subject Inventions
7.4.1.1 Collaborators' Instruction to Employees
7.4.1.2 Timely Invention Disclosure by Inventors
7.4.1.3 Obligation to Provide Invention Disclosures to the Other Collaborator
7.4.2 Determination of Subject Inventions
7.4.3 Title to and Ownership of Subject Inventions
7.4.4 Filing of Patent Applications
7.4.4.1 Filing of Patent Applications on Solely Made Inventions
7.4.4.2 Filing of Patent Applications on Jointly Made Inventions
7.4.4.3 Preserving Intellectual Property Rights
7.4.4.4 Filing Deadlines
7.4.4.5 Copies and Inspection
7.4.4.5.1 Copies of Prosecution Papers
7.4.4.5.2 Access to Patent Application File and Right to Make Copies
7.4.4.6 Rights of Inventors if the Collaborators Decline to File a Patent Application
7.4.5 Nonexclusive License to Subject Inventions
7.4.5.1 Nonexclusive License Grant
7.4.5.2 Confirmatory Nonexclusive License Agreement
7.4.6 Option for Exclusive License to Subject Inventions
7.4.7 Limitation on Assignment of Licenses Granted Under This Agreement
7.4.8 Termination of License Granted and Cancellation of Exclusive License Option to Subject Inventions
7.4.8.1 Exclusive Licenses and Exclusive License Option
7.4.8.2 Nonexclusive Licenses
7.5 Non-Subject Inventions
7.5.1 Ownership of Non-Subject Inventions
7.5.2 Rights Under Other Agreements
7.5.3 No License to Non-Subject Inventions
7.5.4 Preexisting Non-Subject Inventions Pertinent to the Cooperative Work
7.6 Research License

Article 8. TANGIBLE PROPERTY

8.1 Title to Preexisting Tangible Property

8.2 Tangible Property Purchased by Collaborators to Perform the Cooperative Work
8.3 Title to Developed Tangible Property
8.4 Tangible Property Operational and Disposition Costs
8.5 Disposal of Tangible Property

Article 9. LIABILITY

9.1 Extent of Government Liability
9.2 Extent of **[Non-Navy Collaborator]** Liability
9.3 *Force Majeure*

Article 10. GENERAL PROVISIONS

10.1 Characteristics of the Agreement
10.1.1 Entire Agreement
10.1.2 Severability
10.1.3 Interpretation of Headings
10.2 Agreement Between Collaborators
10.2.1 Governing Laws
10.2.2 Independent Parties/Entities
10.2.3 Assignment /Subcontracting
10.2.4 Disputes
10.2.4.1 Settlement and Resolution
10.2.4.2 Continuation of Cooperative Work
10.2.5 Waivers
10.2.6 Use of Name or Endorsements
10.3 Environment, Safety, and Health
10.4 U.S. Competitiveness
10.5 Public Release of This Agreement

Article 11. MODIFICATIONS AND NOTICES

11.1 Amendments
11.2 Termination
11.2.1 Termination by Mutual Consent
11.2.2 Unilateral Termination
11.3 Notices

Article 12. SURVIVING PROVISIONS

Article 13. DURATION

Article 14. SIGNATURES

Appendix A Statement of Work

Appendix B Confirmatory License Agreement

[Insert other Appendices with title as necessary for this Agreement]

STANDARD

NAVY COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENT

BETWEEN

NAVAL POSTGRADUATE SCHOOL

AND

[Non-Navy Collaborator]

PREAMBLE

Under authority of the U.S. Federal Technology Transfer Act of 1986 (Public Law 99-502, 20 October 1986, as amended), **NAVAL POSTGRADUATE SCHOOL (NPS)**, located at 1 University Circle, Monterey, CA 93943-5000, and **[Non-Navy Collaborator]**, whose corporate headquarters are located at [supply appropriate address], enter into this Cooperative Research and Development Agreement (CRADA), which shall be binding upon the Collaborators and their assignees according to the clauses and conditions hereof and for the term and duration set forth.

The U.S. Federal Technology Transfer Act of 1986, as amended, provides for making the expertise, capabilities, and technologies of U.S. Federal laboratories accessible to other Federal agencies; units of State or local government; industrial organizations (including corporations, partnerships and limited partnerships, and industrial development organizations); public and private foundations; nonprofit organizations (including universities); or other persons in order to improve the economic, environmental, and social well-being of the United States by stimulating utilization of U.S. Federally funded technology developments and/or capabilities.

NPS has extensive expertise, capabilities, and information in **[technology area]**, and, in accordance with the U.S. Federal Technology Transfer Act, desires to make this expertise and technology available for use in the public and private sectors.

[Non-Navy Collaborator] has the interest, resources, capabilities, and technical expertise to transition the results of Naval research and development for public use.

[ORTA, the previous two paragraphs should be expanded as appropriate to include specific background information.]

NOW THEREFORE, the Collaborators agree as follows.

Article 1. DEFINITIONS

[Note: Specialized definitions required for this Agreement may be added alphabetically within the DEFINITIONS. If specialized definitions are added, they must be included in the Table of Contents.]

As used in this Agreement, the following terms shall have the meanings defined below, which are equally applicable to both the singular and plural forms of nouns or any tense of verbs.

1.1 "Agreement" means this Cooperative Research and Development Agreement (CRADA) with its Appendices.

1.2 "Classified Information" means all Data classified in accordance with the national security laws of the United States.

1.3 "Collaborator" means the Navy participant or the Non-Navy participant represented and bound by the signatories of this Agreement.

1.4 "Controlled Unclassified Information (CUI)" means Government Data, Information, or materials provided to or resulting from this Agreement that may be export controlled, sensitive, for official use only, or otherwise protected by law, executive order, or regulation.

1.5 "Cooperative Work" means research, development, engineering, or other tasks performed under this Agreement by **NPS** or **[Non-Navy Collaborator]** working individually or together, pursuant to the Objectives (Article 2) and the Statement of Work (Appendix A).

1.6 "Data" means recorded information of any kind regardless of the form or method of the recording, including computer software.

1.7 "Effective Date" means the date of the last signature of the Collaborators executing this Agreement.

1.8 "Exclusive License" means the grant by the owner of Intellectual Property of the exclusive right to make, use, or sell a patented invention.

1.9 "Government" means the Government of the United States of America.

1.10 "Government Purpose Rights" means the right of the Government to use, duplicate, or disclose Data, in whole or in part, and in any manner, for Government purposes only, and to have or permit others to do so for Government purposes only.

Government Purpose Rights includes competitive procurement, but does not include the right to have or permit others to use Data for commercial purposes.

1.11 "Information" means all data, trade secrets, and commercial and financial information. (Chapter 5 Subsection II of Title 5 USC)

1.12 "Intellectual Property" means the property of ideas, examples of which include, but are not limited to, patents, trademarks, copyrights, and trade secrets.

1.13 "Invention" means any invention or discovery that is or may be patentable or otherwise protected under Title 35, United States Code, or any novel variety of plant that is or may be patentable under the Plant Variety Protection Act. (15 USC 3703(9)).

1.14 "Invention Disclosure" means the document identifying and describing to organizational management the Making of an Invention.

1.15 "Made" when used in conjunction with any Invention means the conception or first actual reduction to practice of such Invention. (15 USC 3703(10))

1.16 "Militarily Critical Technologies (MCT)" means those technologies identified in the Militarily Critical Technologies List and under the Export Administration Act of 1979, as amended.

1.17 "Non-Subject Data" means any Data that are not Subject Data.

1.18 "Non-Subject Invention" means any Invention that is not a Subject Invention.

1.19 "Patent Application" means an application for patent protection for an Invention with any domestic or foreign patent-issuing authority.

1.20 "Principal Investigator (PI)" means that person having the responsibility for the performance of the Cooperative Work on behalf of a Collaborator.

1.21 "Proprietary Information" means information that embodies trade secrets developed at private expense or business, commercial, or financial information that is privileged or confidential provided that such information:

is not known or available from other sources without obligations concerning its confidentiality;

has not been made available by the owners to others without obligation concerning its confidentiality;

is not already available to the Government without obligation concerning its confidentiality; and

has not been developed independently by persons who have had no access to the information. (FAR/DFARS Definition)

1.22 "Restricted Access Information" means Subject Data generated by **NPS** that would be Proprietary Information if the Information had been obtained from a non-Federal Collaborator participating in a CRADA (15 USC 3710a). Under 15 USC 3710a(c)(7)(B), the Collaborators mutually may agree to provide appropriate protection to Subject Data generated by **NPS** (Restricted Access Information) against public dissemination or release under the Freedom of Information Act (FOIA) for a period of up to five (5) years after development of the Information.

1.23 "Subject Data" means that Data first recorded in the performance of the Cooperative Work.

1.24 "Subject Invention" means any Invention Made in the performance of the Cooperative Work.

1.25 "Tangible Property" means personal or real property that can be physically touched or held.

1.26 "Unlimited Rights" means the right to use, modify, reproduce, release, disclose, perform, or display Data or Computer Programs in whole or in part, in any manner and for any purpose whatsoever, and to have or permit others to do so.

Article 2. OBJECTIVES

[*Describe the specific, realizable results or benefits to be gained by each Collaborator at the conclusion of this Agreement. State the desired outcome by each Collaborator, including any intentions for commercialization, if appropriate. This Article and the Statement of Work, Appendix A, are the defining articles for the Cooperative Work to be done by the Collaborators.]*

Article 3. RESPONSIBILITIES

The Collaborators shall provide personnel, facilities, and equipment necessary for, and shall perform, the Cooperative Work.

3.1 NPS Personnel and Facilities

The Cooperative Work done by **NPS** will be performed under the program guidance of **[name],** PI, **NPS** Code **[supply organizational code identification]**, who has the responsibility for the scientific and technical conduct of the Cooperative Work performed within the facilities of **NPS** or done on behalf of **NPS** by third parties in support of this Agreement.

[Note to ORTA: If service or support contractor personnel are being used by Navy Collaborator, refer to the Navy CRADA Handbook (Handbook).]

[Non-Navy Collaborator] personnel who perform Cooperative Work at **NPS** facilities will be supervised by the **[Non-Navy Collaborator]** PI.

3.2 **[Non-Navy Collaborator]** Personnel and Facilities

The Cooperative Work done by **[Non-Navy Collaborator]** will be performed under the program guidance of **[name]**, **[Non-Navy Collaborator]** PI, who has the responsibility for the scientific and technical conduct of the Cooperative Work performed within the facilities of **[Non-Navy Collaborator]** or done on behalf of **[Non-Navy Collaborator]** by third parties in support of this Agreement.

NPS personnel who perform Cooperative Work at **[Non-Navy Collaborator]** facilities will be supervised by the **NPS** PI.

3.3 Security Regulations and Directives

Each Collaborator will abide by the safety and security regulations and directives of the host facility in which the Cooperative Work is being performed.

[This is the place to add any special security requirements for personnel doing Cooperative Work at the Collaborators' facilities. If the Cooperative Work covers unclassified Military Critical Technology (MCT), the non-Government Collaborator must be certified to handle MCT data. MCT data must be controlled in accordance with the International Trade in Arms Regulations (ITAR). MCT certification is established using DD Form 2345, called an "Export-Controlled DoD Technical Data Agreement". If the Cooperative Work covers classified topics, a security clearance

must be put in place for the Non-Navy Collaborator's facilities and personnel using a DoD Contract Security Classification Specification, DD Form 254, completed through NPS's Security Office. Refer to the CRADA Handbook.]

Article 4. REPRESENTATIONS AND WARRANTIES

4.1 **NPS**'s Representations and Warranties

NPS hereby warrants and represents to **[Non-Navy Collaborator]** as follows:

4.1.1 **NPS** is a Federal laboratory of the U.S. Department of the Navy (Navy) as defined by 15 USC 3710a(d)(2)(A) and Department of Defense Instruction 5535.8, dated May 14, 1999.

4.1.2 The performance of the activities specified by this Agreement is consistent with the [specify the appropriate mission area] and technology transfer missions of **NPS** (15 USC 3710a).

4.1.3 The Department of the Navy official executing this Agreement for **NPS** has the requisite power and authority to enter into this Agreement and to bind **NPS** to perform according to the terms of this Agreement.

4.2 **[Non-Navy Collaborator]**'s Representations and Warranties

[Non-Navy Collaborator] hereby warrants and represents to **NPS** as follows:

[The following Article 4.2.1 is for a single commercial entity. Choose the appropriate alternatives to Article 4.2.1 from those listed in the Handbook according to the nature of the Non-Navy Collaborator: a university, nonprofit entity, State or local government, directly or indirectly foreign owned, controlled, or influenced (FOCI) entity, multiple collaborators, and their respective means of organization and/or State laws.]

4.2.1 **[Non-Navy Collaborator]** is not directly or indirectly controlled by a foreign company or government (Executive Order 12591, Section 4 (a)). **[Non-Navy Collaborator]**, as of the Effective Date of this Agreement, is a corporation duly organized, validly existing, and in good standing under the laws of **[indicate State or Commonwealth]**.

4.2.2 The official executing this Agreement for **[Non-Navy Collaborator]** has the requisite power and authority to enter into this Agreement and to bind **[Non-Navy Collaborator]** to perform according to the terms of this Agreement.

[The following Article 4.2.3 is for a single commercial entity. Choose the appropriate alternatives to Article 4.2.3 from those listed in the Handbook according to the nature of the organization as private industry, university, or nonprofit entity, State or local government, or FOCI and their respective means of organization and/or State laws.]

4.2.3 The Board of Directors and stockholders of **[Non-Navy Collaborator]** have taken all actions required by law, its Certificate or Articles of Incorporation, its bylaws or otherwise, to authorize the execution and delivery of agreements, such as this Agreement.

4.2.4 The execution and delivery of this Agreement does not contravene any material provision of, or constitute a material default under, any agreement binding on **[Non-Navy Collaborator]**. Furthermore, the execution and delivery of this Agreement does not contravene any material provision of, or constitute a material default under, any valid order of any court, or any regulatory agency or other body having authority to which **[Non-Navy Collaborator]** is subject.

4.2.5 **[Non-Navy Collaborator]** is not presently subject to debarment or suspension by any agency of the Government. Should **[Non-Navy Collaborator]** be debarred or suspended during the term of this Agreement or thereafter, **[Non-Navy Collaborator]** will notify **NPS** within thirty (30) days of receipt of a final notice. **NPS** may then elect to terminate this Agreement and any licenses and options granted under this Agreement.

4.2.6 **[Non-Navy Collaborator]** [is/is not] a small business as defined in 15 USC 632 and implementing regulations (13 CFR 121.101 et seq.) of the Administrator of the Small Business Administration.

4.3 Joint Representations

The Collaborators make the following representations.

4.3.1 There is no express or implied warranty as to any research, Invention, or product, whether tangible or intangible. In particular, the Collaborators make no express or implied warranty as to the merchantability or fitness for a particular purpose of any research, Invention, or product, whether tangible or intangible. Likewise, the Collaborators make no express or implied warranty as to any Cooperative Work, Subject Invention, Subject Data, or other product resulting from the Cooperative Work.

4.3.2 The use and dissemination of Information and materials exchanged under this Agreement will be in accordance with all U.S. laws and regulations, including those pertaining to national security and export control. Nothing in this Agreement shall be construed as a license to export Information or to permit any disclosure in violation of law, regulation, or Department of Defense policy. The exporting Collaborator is responsible for obtaining any export licenses that may be required by U.S. Federal law.

Article 5. FUNDING

[IF PAYMENTS ARE TO BE MADE directly from Non-Navy Collaborator to Navy Collaborator, use the following Articles.]

5.1 Payment Schedule

[Non-Navy Collaborator] agrees to pay **NPS** the following fees/costs in accordance with the payment schedule below:

[Insert amount to be paid, identify the task for which payment is made, the schedule of the tasks, and date of payment or, if preferred, the date and amount of each scheduled payment.]

Checks will be payable to:

[Specify endorsement. Do not specify an individual by name but rather an organization (or job title or function) that has the requisite authority to receive funds for the Navy.]

Each check and its cover correspondence shall refer to Navy CRADA number "NCRADA-**NPS-[last two digits of CY]-[lab CRADA sequence number]**."

Checks will be mailed to:

Director, Research and Sponsored Programs Office
Naval Postgraduate School (Code 91)
Halligan Hall, Room 222
Monterey, CA 93943-5138

5.2 Insufficient and Excess Funds

NPS may discontinue performance under this Agreement if the funds provided by **[Non-Navy Collaborator]** for performance by **NPS** are insufficient or are not provided as specified in Article 5.1. In the event **[Non-Navy Collaborator]** fails to tender the Government the required payment within fifteen (15) days after its respective due date, **[Non-Navy Collaborator]** shall be in default under this Agreement for failure

to make payments. If **[Non-Navy Collaborator]** is in default for this reason, **NPS** shall notify **[Non-Navy Collaborator]**. If **[Non-Navy Collaborator]** does not cure the default within fifteen (15) days of mailing date of notice, **NPS** may proceed to terminate the Agreement in accordance with Article 11.2.2, may cancel any option for an Exclusive License to a Subject Invention, and may terminate any Exclusive License granted pursuant to this Agreement.

Funds that **[Non-Navy Collaborator]** paid under Article 5.1 and that **NPS** has not obligated or expended at the time of completion, expiration, or termination of this Agreement shall be returned to **[Non-Navy Collaborator]** after **NPS**'s submission of a final fiscal report to **[Non-Navy Collaborator]**.

5.3 No New Commitments

NPS shall make no new commitments concerning this Agreement after receipt of a written termination notice from **[Non-Navy Collaborator]** in accordance with Article 11.2 and shall, to the extent practicable, cancel all outstanding commitments by the termination date. Should such cancellation result in any costs incurred by **NPS**, **[Non-Navy Collaborator]** agrees that such costs shall be chargeable against any funding that it provided to **NPS**.

5.4 Accounting Records

NPS shall maintain current accounts, records, and other evidence supporting all its expenditures against funding provided by **[Non-Navy Collaborator]** under this Agreement and shall retain such records for at least twelve (12) months after the completion, expiration, or termination of this Agreement. **NPS** shall provide **[Non-Navy Collaborator]** a financial report within four (4) months after completion, expiration, or termination of this Agreement.

[IF NO PAYMENTS ARE TO BE MADE by Non-Navy Collaborator to Navy Collaborator, or Navy Collaborator is using in-house funding or Government funds already received, use ONLY the following phrase and remove Article Titles 5.1 through 5.4 from the Table of Contents]

Each Collaborator will fund its own efforts.

[Consult the Handbook for the situations in which payments are made only after the completion of a critical milestone in the Cooperative Work or in the case where Navy Collaborator's participation is contingent upon receipt of funds from another Government Organization.]

Article 6. REPORTS AND PUBLICATIONS

6.1 Interim Reports

The Collaborators shall submit **[optional: insert number or frequency for each interim written report]** interim written reports to each other on the progress of the Cooperative Work as mutually agreed.

6.2 Final Reports

The Collaborators shall submit to each other a final report within four (4) months of the completion, termination, or expiration of this Agreement that includes the results obtained and a list of all Subject Inventions Made.

6.3 Agreement to Confer Prior to Publication or Public Disclosure

The Collaborators agree to confer and consult prior to any publication or public disclosure of Subject Data to ensure that no Proprietary Information, Restricted Access Information, Government Classified Information, CUI, or MCT Information is released and that patent rights are not compromised. Prior to any such publication or public disclosure of Subject Data, each Collaborator shall be offered a period not less than fifteen (15) days and not to exceed thirty (30) days, unless otherwise mutually agreed in writing by the Collaborators, to review any proposed abstract, publication, presentation, or other document for public disclosure that contains Subject Data. For the purposes of this Article, the term "disclosure" shall include, but not be limited to, submission of any manuscript for peer review prior to publication. It is the responsibility of the Collaborator intending to make public disclosure of Subject Data to notify the other Collaborator of such intent.

If a Collaborator objects to a proposed public disclosure, that Collaborator must so notify the other Collaborator within thirty (30) days of the date of notice of intent to disclose publicly. If no objection is received by the Collaborator intending to make public disclosure, concurrence is assumed. If a Collaborator objects on the grounds that patent rights may be compromised, a Patent Application must be filed by the responsible Collaborator within ninety (90) days of the date of notification of intent to make public disclosure, or by another date mutually agreed to by the Collaborators. If a Collaborator objects to the release of Information on the grounds that the Information is Proprietary Information, Restricted Access Information, or Information whose dissemination is restricted by U.S. security laws or regulations, the disclosure shall be postponed until the Information no longer meets the definitions of Proprietary Information, Restricted Access Information, or is no longer covered by U.S. security laws or regulations.

6.4 Classified Information

Any presentation that includes Subject Data that are Classified Information or otherwise restricted Data must have prior review and approval by **NPS** pursuant to the pertinent security laws, regulations, and directives.

Article 7. INTELLECTUAL PROPERTY

7.1 Data

7.1.1 General Provisions Applying to All Data

7.1.1.1 Ownership

Each Collaborator shall have title to all Data generated by that Collaborator.

7.1.1.2 No Implied License

Unless otherwise specifically provided, the Collaborators agree that the exchange of Data of any kind does not confer a license to any Invention claimed in any patent or Patent Application or to the subject matter of any copyright, trademark/service mark, or other form of Intellectual Property protection.

7.1.1.3 Marking of Data

7.1.1.3.1 Data Provided With Less Than Unlimited Rights

Each Collaborator shall mark all Data that it provides with less than Unlimited Rights with a marking that clearly identifies the limited rights.

7.1.1.3.2 Data That are Proprietary Information or Restricted Access Information

[Non-Navy Collaborator] shall place a proper proprietary marking on each medium used for recording Data that **[Non-Navy Collaborator]** delivers to **NPS** under this Agreement that **[Non-Navy Collaborator]** asserts is Proprietary Information. **[Non-Navy Collaborator]** shall request in writing if it wishes Subject Data generated by **NPS** to be marked as Restricted Access Information. The Collaborators together shall confer to determine if such marking is appropriate, with reference to the Definitions of Article 1. If the Collaborators mutually agree to the marking then:

(a) For Non-Subject Data that are Proprietary Information, the marking shall read:

"PROPRIETARY INFORMATION OF **[Non-Navy Collaborator] NPS** MAY USE ONLY FOR PURPOSE OF CRADA NUMBER "NCRADA-NPS [last two digits of CY]-[lab CRADA sequence number]";

(b) For Subject Data that are Proprietary Information, the marking shall read:

"PROPRIETARY INFORMATION OF **[Non-Navy Collaborator]** – GOVERNMENT HAS GOVERNMENT PURPOSE RIGHTS UNDER CRADA NUMBER "NCRADA-NPS-[last two digits of CY]-[lab CRADA sequence number]";

(c) For Data that are Restricted Access Information, the marking shall read:

"RESTRICTED ACCESS INFORMATION – PROTECT IN ACCORDANCE WITH CRADA NUMBER **"NCRADA-NPS-**[last two digits of CY]-[lab CRADA sequence number]" UNTIL [INSERT DATE: Insert negotiated date not to exceed five (5) years from the generation of a Restricted Access Information document]".

[ORTA, insert full name of Non-Navy Collaborator in the statements above and see Handbook regarding date for Restricted Access Information.

7.1.1.3.3 Data That are Subject to 35 USC 205

NPS shall mark Data it provides under this Agreement that disclose one or more Inventions in which the Government owns or may own a right, title or interest, and that are subject to confidentiality under 35 USC 205. Such Data shall be marked:

"NAVAL POSTGRADUATE SCHOOL DATA PROTECTED FROM RELEASE OR DISCLOSURE UNDER 35 USC 205.**"**

[Note to ORTA: Insert full name of Navy Collaborator in the above marking.]

7.1.1.3.4 Data That are Classified Information, CUI, MCT, or Otherwise Restricted

Each Collaborator shall mark all Data that are Classified Information, CUI, MCT, or otherwise restricted by U.S. security or export control laws or regulations that it provides under this Agreement.

[Note to ORTA: No standard marking is provided. Marking will vary according to the type of Data provided and should be consistent with Navy Collaborator's marking regulations and policies.]

7.1.1.4 Protection of Data

Except for the rights granted in Article 7.1.2.2, Data shall be protected in accordance with the proper markings of its owner and as provided by, at a minimum, the requirements of 15 USC 3710a. Proprietary Information will be protected only if it is properly marked as such. Information provided in intangible form that is Proprietary Information must be designated Proprietary Information at the time it is delivered, followed within fifteen (15) days by a writing summarizing the exact Information to be protected. The Collaborator receiving Information in an intangible form that is designated as Proprietary Information shall be responsible for protecting the Information as Proprietary Information during the fifteen (15) day notification period. After the fifteen (15) day period, if no written summary has been received, the receiving Collaborator need not continue to protect the Information received in intangible form.

Restricted Access Information shall be protected from public dissemination for up to five (5) years, as mutually agreed.

Classified Information, CUI, MCT, or otherwise restricted Information shall be protected in accordance with the security laws of the United States.

7.1.1.5 Release of Data Under the Freedom of Information Act

Data in the possession of **NPS** that are not marked CUI, Proprietary Information of **[Non-Navy Collaborator]** or Restricted Access Information must be released by **NPS** where such release is required pursuant to a request under the Freedom of Information Act (FOIA) (5 USC 552). **NPS** shall protect Data that are properly marked CUI, Proprietary Information of **[Non-Navy Collaborator]** or Restricted Access Information from release under the FOIA for as long as the marked Data meet the definition of CUI, Proprietary Information or Restricted Access Information. Prior to release of any such Data**, NPS** shall promptly notify **[Non-Navy Collaborator]** of any request for Data of **[Non-Navy Collaborator]** regardless of whether the requested Data are marked Proprietary Information.

7.1.2 Subject Data

7.1.2.1 Delivery of Requested Subject Data

Each Collaborator shall have the right to review and receive delivery of all Subject Data generated by the other Collaborator. Requested Subject Data shall be delivered to the requesting Collaborator within fifteen (15) days of the request.

7.1.2.2 Rights in Subject Data

Except as represented in Article 4.3.2, the Collaborators shall have Unlimited Rights in all Subject Data that are not Proprietary Information or Restricted Access Information. Notwithstanding 15 USC 3710a, **[Non-Navy**

Collaborator] grants Government Purpose Rights in any Subject Data furnished by **[Non-Navy Collaborator]** to **NPS** under this Agreement that are properly marked as Proprietary Information. The Government has Government Purpose Rights in Subject Data that are Restricted Access Information.

7.1.3 Rights in Non-Subject Data

The Collaborators shall have Unlimited Rights in any Non-Subject Data delivered under this Agreement that are not Proprietary Information**.**

NPS has a limited right to use, reproduce, and disclose only to Government employees for use in support of the Cooperative Work any Non-Subject Data that are properly marked as Proprietary Information and are provided by **[Non-Navy Collaborator]** under this Agreement. Such Proprietary Information can be used only for the purpose of performing the Cooperative Work unless consent to other use or disclosure is obtained from **[Non-Navy Collaborator]** in writing.

[Non-Navy Collaborator] shall have a limited right to use, reproduce, or disclose Non-Subject Data that may describe one or more Inventions in which the Government owns or may own a right, title or interest, if such Non-Subject Data are provided by **NPS** under this Agreement. In accordance with 35 USC 205, such Non-Subject Data are to be held in confidence. Such Non-Subject Data shall be properly marked by **NPS** and the limited rights of **[Non-Navy Collaborator]** shall be defined by a separate non-disclosure agreement.

7.2 Copyrights

7.2.1 Copyright by **[Non-Navy Collaborator]**

[Non-Navy Collaborator] may copyright works of authorship prepared pursuant to this Agreement if eligible for copyright protection under Title 17 USC.

7.2.2 Copyright License to the Government

[Non-Navy Collaborator] grants to the Government a nonexclusive, irrevocable, paid-up license in copyrighted works of authorship, including software (17 USC 106) prepared pursuant to this Agreement for any purpose, consistent with the rights in Data described in Article 7.1.

7.2.3 Copyright Statement

[Non-Navy Collaborator] shall include the following statement on any text, drawing, mask work or other work of authorship, that may be copyrighted under 17 USC, that is created in the performance of this Agreement:

"The U.S. Government has a copyright license in this work pursuant to a Cooperative Research and Development Agreement with **NAVAL POSTGRADUATE SCHOOL**."

[ORTA: Insert the full name of Navy Collaborator in the statement above.]

7.3 Trademarks and Service Marks

7.3.1 Ownership of Trademarks and Service Marks

The Collaborator first establishing a trademark or service mark for goods or services with which the mark is used shall be considered the owner of the mark.

7.3.2 Obligation of Employees to Report Trademarks and Service Marks

Employees of both Collaborators shall report the adoption of a trademark or service mark associated with the Cooperative Work to their employer within thirty (30) days of the first use of the mark. Use includes internal use of any product or service of the Cooperative Work.

7.3.3 Obligation of Collaborators to Notify Each Other

Each Collaborator shall notify the other Collaborator within thirty (30) days of their employee's report of the first use of a trademark or service mark.

7.3.4 Responsibility for Filing an Application for Trademark or Service Mark

The Collaborator owning a trademark or service mark shall establish the use of the mark in intra- and interstate commerce and shall be responsible for filing all applications for trademark or service mark registration as appropriate.

7.3.5 License to Use Trademark or Service Mark

The Collaborator owning the trademark or service mark as defined in Article 7.3.1, shall grant a paid-up, irrevocable, nonexclusive license to the other Collaborator for use of the trademark or service mark on the goods or services for which the mark is intended to be used.

7.4 Subject Inventions

7.4.1 Obligation to Report Subject Inventions

7.4.1.1 Collaborators' Instructions to Employees

Each Collaborator shall instruct its employees to submit an Invention Disclosure to that Collaborator for all innovations, solutions to technical problems, or unique increases to the general body of knowledge resulting from the Cooperative Work. For the purposes of this Article, these innovations, solutions, and increases to knowledge shall be deemed Inventions.

7.4.1.2 Timely Invention Disclosure by Inventors

Within ninety (90) days of Making an Invention resulting from the Cooperative Work, unless a shorter time period is required by circumstances, the inventor(s) shall submit an Invention Disclosure to their employer.

In the case of an Invention Made jointly by inventors from both Collaborators, the inventors shall submit an Invention Disclosure with their respective employer.

7.4.1.3 Obligation to Provide Invention Disclosures to the Other Collaborator

Each Collaborator shall provide the other Collaborator with a copy of each Invention Disclosure reporting a Subject Invention within sixty (60) days of receiving the Invention Disclosure from its inventor(s).

7.4.2 Determination of Subject Inventions

The Collaborators shall review each Invention Disclosure resulting from the Cooperative Work and shall confer and consult to determine whether an Invention Disclosure represents a Subject Invention.

7.4.3 Title to and Ownership of Subject Inventions

Each Collaborator shall be entitled to own the Subject Inventions of its employees. Each Collaborator shall cooperate with the other Collaborator to obtain inventor signatures on Patent Applications, assignments or other documents required to secure Intellectual Property protection. For any Invention Made jointly by employees of

the Collaborators, each Collaborator shall have ownership of the Subject Invention in the form of an undivided interest.

7.4.4 Filing of Patent Applications

7.4.4.1 Filing of Patent Applications on Solely Made Inventions

Each Collaborator has primary responsibility for filing Patent Applications on the Subject Inventions of its employee(s).

Notwithstanding such primary responsibility, by mutual agreement, the Collaborators may identify which Collaborator shall file a Patent Application on any Subject Invention.

7.4.4.2 Filing of Patent Applications on Jointly Made Inventions

In the case of an Invention jointly Made by employees of both Collaborators, the Collaborators shall confer and agree as to which Collaborator will file any Patent Application. Officers of the non-filing Collaborator shall cooperate with the filing Collaborator to obtain signatures on documents that are needed to file a Patent Application.

7.4.4.3 Preserving Intellectual Property Rights

The Collaborator responsible for filing of a Patent Application on any Subject Invention shall file such Patent Application at least sixty (60) days prior to any bar date or one year from the date the Invention Disclosure was received, whichever comes first. If no Patent Application is filed within the specified time period, the other Collaborator may assume control of filing the Patent Application and take title to the Subject Invention on ten (10) days written notification. The Collaborator that relinquished the responsibility to file shall retain a nonexclusive, irrevocable, paid-up license to practice the Subject Invention or have the Subject Invention practiced throughout the world by or on its behalf.

7.4.4.4 Filing Deadlines

The Collaborator responsible for filing any Patent Application for a Subject Invention shall notify the other Collaborator of all filing deadlines for prosecution of any Patent Application and maintenance of any patents on the Subject Invention. Notwithstanding the primary responsibility defined in Article 7.4.4.1, sixty (60) days prior to any filing deadline, the Collaborators shall confer to

determine if the filing Collaborator intends to respond to the filing deadline. The non-filing Collaborator will be permitted to take action if the filing Collaborator declines.

7.4.4.5 Copies and Inspection

7.4.4.5.1 Copies of Prosecution Papers

Each Collaborator filing a Patent Application on a Subject Invention shall provide the other Collaborator with a copy of any communication relating to prosecution of said Patent Application within thirty (30) days of receipt of such communication.

7.4.4.5.2 Access to Patent Application File and Right to Make Copies

Upon written request, the filing Collaborator shall give the other Collaborator a Power of Attorney or an Authorization to Act in a Representative Capacity with respect to any Subject Invention(s). In the event the filing Collaborator fails or declines to take action, the other Collaborator shall be empowered to do all that is necessary to secure Intellectual Property protection for the Subject Invention.

7.4.4.6 Rights of Inventors if the Collaborators Decline to File a Patent Application

In the event both Collaborators decline to file a Patent Application on a Subject Invention, the Government will renounce its entitlement and leave its rights to the inventor(s) who may retain ownership of the Invention, subject to the retention by each Collaborator of a nonexclusive, irrevocable, paid-up license to practice the Subject Invention or have the Invention practiced throughout the world by or on its behalf.

In the event both Collaborators decline to file a Patent Application on a Subject Invention, **[Non-Navy Collaborator]** may, at its sole discretion, renounce its entitlement and leave its rights to the inventor(s) who may retain ownership of the Invention, subject to the retention by each Collaborator of a nonexclusive, irrevocable, paid-up license to practice the Subject Invention or have the Invention practiced throughout the world by or on its behalf.

7.4.5 Nonexclusive License to Subject Inventions

7.4.5.1 Nonexclusive License Grant

Each Collaborator grants to the other Collaborator a nonexclusive, irrevocable, paid-up license to practice a Subject Invention Made by

employees of the granting Collaborator or have the Subject Invention practiced throughout the world by or on behalf of the other Collaborator. No nonexclusive license granted under this Agreement shall permit licensee to grant sublicenses.

7.4.5.2 Confirmatory Nonexclusive License Agreement

Each Collaborator has the obligation to provide a Confirmatory License Agreement (Appendix B) to the other Collaborator for each nonexclusive license within ninety (90) days of the date of filing.

7.4.6 Option for Exclusive License to Subject Inventions

NPS gives **[Non-Navy Collaborator]** the option of acquiring an Exclusive License for the field of use **[state field of use]** in the Government's rights in any Subject Invention Made in whole or in part by a **NPS** employee. The license shall be for reasonable consideration. In order to exercise this option, **[Non-Navy Collaborator]** must notify **NPS** in writing within one hundred and eighty (180) days of the filing of a Patent Application. Unless another time period is mutually agreed upon between the Collaborators, **[Non-Navy Collaborator]** must execute an Exclusive License to the Subject Invention within one hundred and eighty (180) days of election to exercise the option, or the Invention shall be made available for licensing by the public in accordance with 37 CFR Part 404.

Any Exclusive License granted by the Government in a Subject Invention is subject to the statutorily required reservation by the Government of a nonexclusive, irrevocable, paid-up license to practice the Subject Invention or have that Subject Invention practiced throughout the world by or on behalf of the Government (15 USC 3710a).

7.4.7 Limitation on Assignment of Licenses Granted Under This Agreement

No license granted under this Agreement shall be assigned, licensed or otherwise disposed of except to the successor in interest of that part of **[Non-Navy Collaborator]**'s business to which such license pertains.

[The following Article 7.4.8 is to be used for a Non-Navy Collaborator that is "not" directly or indirectly foreign owned, controlled, or influenced (FOCI). For FOCI organizations identified as such in Article 4.2.1, use the appropriate alternative to Article 7.4.8 listed in the CRADA Handbook under "MODIFICATIONS FOR CRADAs WITH A FOCI ENTITY".]

7.4.8 Termination of License Granted and Cancellation of Exclusive License Option to Subject Inventions

7.4.8.1 Exclusive Licenses and Exclusive License Option

NPS may terminate any Exclusive License or cancel any option for an Exclusive License to a Subject Invention granted under this Agreement in the event that:

(a) **[Non-Navy Collaborator]** is in default for failure to make payment as agreed in Article 5; or

(b) The Agreement is terminated unilaterally by **[Non-Navy Collaborator]**; or

(c) **[Non-Navy Collaborator]** fails to perform according to the Statement of Work (Appendix A); or

(d) **[Non-Navy Collaborator]** becomes a foreign owned, controlled, or influenced (FOCI) organization that does not qualify under the requirements of Executive Order 12591, Section 4(a).

7.4.8.2 Nonexclusive Licenses

NPS shall terminate any nonexclusive license to a Subject Invention granted under this Agreement if **[Non-Navy Collaborator]** becomes a FOCI organization that does not qualify under the requirements of Executive Order 12591, Section 4(a).

7.5 Non-Subject Inventions

7.5.1 Ownership of Non-Subject Inventions

Each Collaborator owns its Non-Subject Inventions.

7.5.2 Rights Under Other Agreements

Nothing in this Agreement is intended to change the rights in Intellectual Property acquired by the Collaborators in any other contract or agreement between the **[Non-Navy Collaborator]** and the Government**.**

7.5.3 No License to Non-Subject Inventions

This Agreement does not grant any Collaborator a license, express or implied, to any Non-Subject Invention.

[Each paragraph in the following Article 7.5.4 is optional.]

7.5.4 Preexisting Non-Subject Inventions Pertinent to the Cooperative Work

Non-Subject Inventions Made prior to the Effective Date and pertinent to the Cooperative Work that are specifically identified as property of **NPS** include but are not limited to the following:

[List Invention Title, inventor name(s), patent number, or Navy case number if an Invention disclosure, or Patent Application Serial Number, and date of issue (for patents only).]

Non-Subject Inventions Made prior to the Effective Date and pertinent to the Cooperative Work that are specifically identified as property of [Non-Navy Collaborator] **include but are not limited to the following:**

[List Invention Title, inventor name(s), patent number, or attorney's docket number if an Invention disclosure or Patent Application Serial Number, and date of issue (for patents only).]

7.6 Research License

Each Collaborator shall allow the other Collaborator to practice any of its Non-Subject Inventions for the purpose of performing the Cooperative Work.

No license, express or implied, for commercial application(s) is granted to either Collaborator in Non-Subject Inventions by performing the Cooperative Work.

For commercial application(s) of Non-Subject Inventions, a license must be obtained from the owner.

Article 8. TANGIBLE PROPERTY

8.1 Title to Preexisting Tangible Property

Each Collaborator shall retain title to all Tangible Property to which it had title prior to the Effective Date of this Agreement.

8.2 Tangible Property Purchased by Collaborators to Perform the Cooperative Work

Each Collaborator shall retain title to all Tangible Property that it purchases during the period of this Agreement. **[Non-Navy Collaborator]** cannot take

title to any Government Tangible Property under this Agreement**.** Collaborator consumables to be used in the Cooperative Work of this Agreement are the property of the purchasing Collaborator until consumed.

8.3 Title to Developed Tangible Property

All Tangible Property developed under this Agreement with all components purchased by one Collaborator shall be the property of that Collaborator. Tangible Property having any component purchased by **NPS** shall be the property of the Government, unless such Tangible Property can reasonably be separated without damage to the other individual components. After this Agreement is completed, expired, or terminated, if separation of components can be made without damage, the Collaborators may, by mutual agreement, separate the Tangible Property into its components and the separated components shall remain the property of the Collaborator that purchased them.

8.4 Tangible Property Operational and Disposition Costs

During the period of and upon completion, expiration, or termination of this Agreement, each Collaborator shall be responsible for all costs of maintenance, removal, storage, repair, disposal, and shipping of all Tangible Property to which it has title.

8.5 Disposal of Tangible Property

Disposal of Tangible Property shall be in accordance with applicable U.S. Federal, State, and local property disposal laws, environmental laws, and regulations.

Article 9. LIABILITY

9.1 Extent of Government Liability

The Government shall be solely liable for the negligent or wrongful acts of its officers and employees to the extent provided for in the Federal Tort Claims Act (28 USC 2671 et. seq.) and in other applicable laws and regulations of the United States that specifically waive sovereign immunity. Nothing in this Agreement shall be construed as a waiver of the sovereign immunity of the United States.

9.2 Extent of **[Non-Navy Collaborator]** Liability

[Non-Navy Collaborator] is solely responsible for its actions and the actions of those acting for **[Non-Navy Collaborator]** in the performance of this Agreement and for any damages that may arise from any suit, action, or claim, and for any costs from or incidental to any suit, action, or claim, including but not limited to settlement and defense costs. Further, **[Non-Navy Collaborator]** agrees that in any suit, action or claim brought by anyone not a party to this Agreement based on actions of

[Non-Navy Collaborator], **[Non-Navy Collaborator]** shall not pursue any actions to enter the Government as a party in such suit, action or claim unless the Government has some liability under the Federal Tort Claims Act.

9.3 *Force Majeure*

No Collaborator shall be liable for the consequences of any *force majeure* that (1) is beyond its reasonable control; (2) is not caused by the fault or negligence of such Collaborator; (3) causes such Collaborator to be unable to perform its obligations under this Agreement; and (4) cannot be overcome by the exercise of due diligence. In the event of the occurrence of a *force majeure*, the Collaborator unable to perform shall promptly notify the other Collaborator. The Collaborators shall suspend performance only for such period of time as is necessary to overcome the result(s) of the *force majeure* and shall use their best efforts to resume performance as quickly as possible.

Article 10. GENERAL PROVISIONS

10.1 Characteristics of the Agreement

10.1.1 Entire Agreement

This Agreement constitutes the entire agreement between the Collaborators concerning the Cooperative Work and supersedes any prior understanding or written or oral agreement relative to the Cooperative Work.

10.1.2 Severability

The illegality or invalidity of any Article of this Agreement shall not impair, affect, or invalidate any other Article of this Agreement.

10.1.3 Interpretation of Headings

Headings of the Articles of this Agreement are for convenience of reference only and do not form a part of this Agreement and shall in no way affect the interpretation thereof.

10.2 Agreements Between Collaborators

10.2.1 Governing Laws

United States Federal Laws shall govern this Agreement for all purposes.

10.2.2 Independent Parties/Entities

The relationship of the Collaborators to this Agreement is that of independent parties and not as agents of each other, partners, or participants in a joint venture. Each Collaborator shall maintain sole and exclusive control over its personnel and operations.

10.2.3 Assignment/Subcontracting

[Note to ORTAs: Refer to the Handbook for a discussion on issues related to the use of contractors during the execution of a CRADA.]

10.2.3.1 Neither Collaborator may allow third parties to perform any part of the Cooperative Work under this Agreement without express written consent of the other Collaborator. If consent is obtained, the Collaborator requesting such consent shall remain fully responsible for the portion of the Cooperative Work to be accomplished under a third-party agreement, and the third party is not a Collaborator of this Agreement. Any third-party agreement to perform a portion of the Cooperative Work shall contain terms consistent with this Agreement.

10.2.3.2 This Agreement shall not be assigned or otherwise transferred by either Collaborator without the prior written consent of the other Collaborator, except to the successor of that part of **[Non-Navy Collaborator]**'s business to which this Agreement pertains.

10.2.3.3 If [Non-Navy Collaborator] or its successor or assignee is a U.S. company, and becomes, during the term of this Agreement or thereafter, directly or indirectly owned, controlled, or influenced by a foreign company or government (FOCI), then [Non-Navy Collaborator] or its successor or assignee shall promptly notify NPS to that effect.

10.2.4 Disputes

10.2.4.1 Settlement and Resolution

NPS and **[Non-Navy Collaborator]** agree to use reasonable efforts to reach a fair settlement of any dispute. If such efforts are unsuccessful, remaining issues in dispute will be referred to the signatories or their successors for resolution. If a dispute continues, the remaining issues may be submitted to the Chief of Naval Research (CNR), or the CNR designee, for resolution. This Agreement does not prevent any Collaborator from pursuing disputes in a U.S. Federal court of competent jurisdiction. No Collaborator will pursue litigation in a U.S. Federal court until after the CNR, or the CNR designee, decides the dispute, or until sixty (60)

days after the dispute was first submitted to the CNR, or the CNR designee, whichever comes first.

10.2.4.2 Continuation of Cooperative Work

If payments or installment payments are to be made as stated under Article 5, **NPS** will not start or continue cooperative work until payments or installment payments are received.

10.2.5 Waivers

None of the provisions of this Agreement shall be considered waived by either Collaborator unless such waiver is given in writing to the other Collaborator, signed by the executing official of this Agreement or the official's successor having the authority to bind the Collaborator making the waiver. The failure of either Collaborator to insist upon strict performance of any of the terms and conditions herein, or failure or delay to exercise any rights provided herein or by law shall not be deemed a waiver of any right of either Collaborator under this Agreement.

10.2.6 Use of Name or Endorsements

Except as provided for in Article 7.2.3, **[Non-Navy Collaborator]** shall not use the name of **NPS** or any other Government entity on any product or service that is directly or indirectly related to either this Agreement or any patent license or assignment associated with this Agreement without the prior approval of **NPS**. By entering into this Agreement, **NPS** does not directly or indirectly endorse any product or service provided, or to be provided, by **[Non-Navy Collaborator]**, its successors, assignees, or licensees. **[Non-Navy Collaborator]** shall not in any way imply that the Department of the Navy endorses any such product or service.

10.3 Environment, Safety, and Health

Each Collaborator shall be responsible for the handling, control, and disposition of any and all hazardous substances or waste in its custody during the course of this Agreement. At the conclusion of this Agreement, each Collaborator shall be responsible for the handling, control, and disposition of any and all hazardous substances or waste still in its possession. Each Collaborator shall obtain at its own expense all necessary permits and licenses as required by U.S. Federal, State, and local law and shall conduct such handling, control, and disposition in a lawful and environmentally responsible manner. Each Collaborator is responsible for all required environmental, safety, and health compliance, notice, and monitoring related to its facility in accordance with U.S. Federal, State, and local law and regulations. Collaborators shall abide by the environmental, safety, and health directives of the host facility in which the Cooperative

Work is being performed, and any U.S. Federal, State, or local laws and regulations pertaining to environment, safety, and health that are applicable to the host facility.

10.4 U.S. Competitiveness

[Non-Navy Collaborator] agrees that any product, process, or service using Intellectual Property arising from the performance of this Agreement shall be manufactured substantially in the United States.

10.5 Public Release of This Agreement

This Agreement, without funding information (Article 5) and Appendices, may be released to the public.

Article 11. MODIFICATIONS AND NOTICES

11.1 Amendments

If a Collaborator wishes to modify this Agreement, the Collaborators shall confer in good faith to determine the desirability of such modification. Such modification shall not be effective until a written amendment is signed by both executing officials of this Agreement or their successors.

11.2 Termination

11.2.1 Termination by Mutual Consent

The Collaborators may elect to terminate this Agreement at any time by mutual consent. Such termination shall not be effective until a written termination agreement is signed by both executing officials of this Agreement or their successors.

11.2.2 Unilateral Termination

A Collaborator may unilaterally terminate this entire Agreement at any time by giving the other Collaborator written notice signed by the executing official of this Agreement or his/her successor, not less than thirty (30) days prior to the desired termination date. If **[Non-Navy Collaborator]** unilaterally terminates this Agreement, any option for an Exclusive License to a Subject Invention and any Exclusive License to a Subject Invention granted by or pursuant to this Agreement shall simultaneously be terminated.

11.3 Notices

All notices pertaining to or required by Articles of this Agreement, except those pertaining solely to the prosecution of any patent, trademark, or service mark, shall be in writing and shall be signed by an authorized representative of the Technology Transfer Office for **NPS** or the preferred contact for **[Non-Navy Collaborator]**, and all such notices shall be delivered by hand, sent by courier with proper registration, or sent by certified mail, return receipt requested, with postage prepaid, addressed as follows:

If to **NAVAL POSTGRADUATE SCHOOL**:

Director, Research and Sponsored Programs Office
Naval Postgraduate School (Code 91)
Halligan Hall, Room 222
Monterey, CA 93943-5138

If to **[Non-Navy Collaborator]**:

[Specify the mailing address for the preferred contact.]

A Collaborator shall notify the other Collaborator of a change of address in the manner set forth above.

Notices pertaining solely to the prosecution of any patent, trademark, or service mark related to this Agreement shall be in writing and shall be signed by and sent to the Collaborator's legal counsel for Intellectual Property. Legal counsel for Intellectual Property for each Collaborator shall send a copy of any such notice to the Technology Transfer Office for **NPS**. If either Collaborator fails to identify such counsel upon request, then such notices shall be sent to the points of contact specified above.

Article 12. SURVIVING PROVISIONS

The Articles covering Definitions, Representations and Warranties, Funding, Reports and Publications, Intellectual Property, Tangible Property, Liability, General Provisions, Modifications and Notices, and Surviving Provisions shall survive the completion, termination, or expiration of this Agreement.

Article 13. DURATION

This Agreement expires **[specify a time no greater than three (3) years]** after its Effective Date, unless otherwise extended in writing according to the provisions of Article 11.

Article 14. SIGNATURES

For **[Non-Navy Collaborator]**:

I, the undersigned, am duly authorized to bind **[Non-Navy Collaborator]** to this Agreement and do so by affixing my signature hereto.

Entered into this _____ day of _____200 ___,

By:
Title:

For the Department of the Navy:

I, the undersigned, by 15 USC 3710a and Navy regulations, am duly authorized to bind the U.S. Navy to this Agreement and do so by affixing my signature hereto.

Entered into this _____ day of _____200___,

By: _____

Superintendent

APPENDIX A

STATEMENT OF WORK

BETWEEN

NAVAL POSTGRADUATE SCHOOL

AND

[Non-Navy Collaborator]

NCRADA-[Navy Org.] – [last two digits of CY] – [serial number]

The Collaborators agree to perform the following tasks:

NAVAL POSTGRADUATE SCHOOL (NPS) will be responsible for the following tasks (list as applicable):

1.
2.
3.

[Non-Navy Collaborator] will be responsible for the following tasks (list as applicable):

1.
2.
3.

NPS and **[Non-Navy Collaborator]** will be responsible for the following joint tasks (if applicable):

1.
2.
3.

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APPENDIX B

CONFIRMATORY LICENSE ***AGREEMENT***	*1. APPLICATION FOR (Title of Invention)*
2. INVENTOR(S) AND AFFILIATION	
3. PATENT APPLICATION SERIAL NO.	*4. PATENT APPLICATION FILING DATE*
5. NAVY ACTIVITY (Name, address, point of contact)	*6. NON-NAVY ACTIVITY (Name, address, point of contact)*
7. CRADA AGREEMENT NO.	*8. DATE OF THIS AGREEMENT*

9. The Invention identified above is a "Subject Invention" under Article 7 Intellectual Property included with the CRADA identified in Box 7 between the Department of the Navy and Non-Navy Activity identified in Box 6.

This document is confirmatory of the nonexclusive, irrevocable, paid-up license to practice the identified Subject Invention or have that Subject Invention practiced throughout the world by or on behalf of the receiving party, and of all other rights acquired by the receiving party by the referenced clause.

This license is granted to

_____ *the Government*

(Select one)

_____ *Non-Navy Activity identified in Box 6*

under this CRADA in the identified Invention, Patent Application and any resulting patent.

The licensee is hereby granted an irrevocable power to inspect and make copies of the above-identified Patent Application.

_____ *ACTIVITY NAME OF LICENSOR*

_____ *SIGNATURE*

_____ *NAME (Typed or Printed)*

_____ *TITLE*

_____ *BUSINESS TELEPHONE*

APPENDIX E

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Naval Postgraduate School Technology Transfer Business Plan

1. **Objective**: The Technology Transfer Program at the Naval Postgraduate School was initiated in response to legislation passed to encourage the transfer of federally funded technologies to the private sector. The primary objectives of the Technology Transfer Program at NPS are to initiate partnerships with industry and/or academia, license existing technologies, and encourage and assist faculty and staff to transfer newly developed technologies to the private sector. Technology Transfer at NPS is served in various forms: Cooperative Research and Development Agreements, patents, and publications.

2. **Organization Overview**: The Naval Postgraduate School is a graduate academic institution whose emphasis is on study and research programs relevant to the Navy's interests, as well as to the interests of other arms of the Department of Defense. Approximately 1400 students attend the Naval Postgraduate School. The student body consists of U.S. Officers from all branches of the uniformed services, officers from approximately 30 other countries and a small number of civilian employees from DoD and other government laboratories. The faculty, the majority of who are civilians, are drawn from a broad diversity of educational institutions and represent a prestigious set of scholars. The academic disciplines of the School are organized into three divisions:

- Division of Computer and Information Sciences and Operations
    - Department of Computer Science
    - Command, Control and Communications, Computers, and Intelligence (C4I) Academic Group
    - Information Systems Academic Group
    - Information Warfare Academic Group
    - Modeling, Virtual Environments, and Simulation Academic Group
    - Space Systems Academic Group
    - Special Operations Academic Group
- Division of Science and Engineering
    - Department of Aeronautics and Astronautics
    - Department of Electrical and Computer Engineering
    - Department of Mathematics
    - Department of Meteorology
    - Department of Oceanography
- Division of Operational and Policy Science
    - Department of National Security Affairs
    - Department of Operations Research
    - Department of Physics

- Department of Systems Management

Research is conducted in every academic department and interdisciplinary group at the Naval Postgraduate School. The research program exists to support the graduate education of the students. It does so by maintaining upper division course content and programs at the cutting edge; challenging students with creative problem solving experiences on DoD relevant issues; advancing DoN/DoD science and technology; solving warfare problems; and, attracting and retaining quality faculty.

3. **Strategy/Plan**: The faculty principal investigator has primarily driven NPS' past participation in the Technology Transfer Program. Networking between the scientists and engineers at NPS with their counterparts at other academic institutions and industry have forged the framework for the cooperative agreements which have been initiated in the past. Faculty research will remain the driver in the future for the establishment of Cooperative Research and Development Agreements, patents, and scholarly publications. To this end, the NPS' Technology Transfer Program will take advantage of the unique environment at NPS which is conducive to the development and organization of collaborative and consortia research initiatives. The primary components of the NPS Technology Transfer Program will include:

- Cooperative Research and Development Agreements: CRADAs are a widely used mechanism which enables a government institution and a private company to work together to develop commercial products or processes from technology owned by the government. The number of agreements initiated and finalized by NPS has risen steadily in the last several years.
- Work for Services: Whereas this activity in itself does not allow for the transfer of technology, it does allow the industrial requestor to learn more of the agencies capabilities and can possibly lead to a follow-on relationship, i.e. CRADA.
- Patents: NPS faculty/students continue to file patent applications when their research reaches a stage which warrants the protection provided.
- Publications: Publication is one of the most basic venues for technology transfer. NPS faculty publish extensively in the refereed journals and other scholarly publications. NPS students are required to complete a thesis as part of their masters' degree. Abstracts of NPS theses are now available on the World Wide Web.
- Memoranda of Understanding/Agreement: Whereas these agreements are with other DoD entities, they can provide the vehicle by which the partnering DoD agencies can seek partnerships outside of DoD.
- Consortia: NPS is actively pursuing partnerships with other academic institutions within the same geographic location. The Monterey Bay Crescent Ocean Research Consortium, which is a confederation of several agencies (education, research, governmental, advocacy) around the Monterey Bay, is focused on the ocean sciences. NPS also participates in the Monterey Bay Education, Science and Technology (MBEST) Center, which is attempting to partner local research organizations to more effectively implement technology transfer.

The Office of the Associate Provost and Dean of Research has responsibility for the NPS Technology Transfer Program. The Associate Provost and Dean of Research is instrumental in liaisoning with entities outside of NPS for raising the awareness of the wide range of outstanding research being conducted at NPS. Functions which provide additional support to the NPS Technology Transfer Program include:

- ORTA Representative: The ORTA representative has primary responsibility for assisting faculty and their industrial partners with the means for initiating cooperative agreements. The ORTA representative also identifies and markets existing NPS technologies.
- Office of General Council Representative: The OGC representative at the Naval Postgraduate School reviews all Cooperative Research and Development Agreements, Memoranda of Understanding/Agreement, and facilitates the patent application process.
- NPS Research Board: The NPS Research Board is comprised of the Associate Chairs of Research from each of the academic departments and interdisciplinary groups. One of the functions of the Board is to serve as the Invention Evaluation Board which reviews/prioritizes patent applications, and considers renewal of maintenance fees for existing patents. The Board is also instrumental in advising the Associate Provost and Dean of Research on policies governing the overall NPS Research Program.
- SBIR Site: NPS has recently become an SBIR site. As such, NPS faculty will be identifying potential SBIR topics and monitoring the progress of those awarded. The NPS Research Board ranks and approves topics submitted for consideration. The SBIR Program is another venue for increased interaction with industry and increases industry's awareness of NPS research and potential.

4. **FY98 in Review**: In FY98, the NPS Technology Transfer program continued to evolve. Whereas the sponsored overall research program at NPS will be approaching $30M in FY98, income received from industrial partnerships is less than 1%. However, potential partnerships and/or applications are continuously being explored.

- NPS entered into four new CRADAs. Industrial partners include Accurate Automation Corporation, Advanced Network and Services, Inc, Applied High Technology Corporation, and TRW. CRADAs were renewed with Analytical Graphics, Inc. and Adroit Systems. Several other agreements are currently being negotiated with industrial partners.
- Two patents were issued to faculty and several other patent applications have been filed. Maintenance fees on existing patents with licensing potential were processed.
- NPS was identified as an SBIR site.
- NPS thesis abstracts have been made available on the World Wide Web.
- The liaison efforts of the Associate Provost and Dean of Research have identified potential industrial partnerships.

5. **Resources**: NPS has vast resources for supporting a Technology Transfer Program. Unique laboratory facilities such as the Center for Interdisciplinary Remotely Piloted Aircraft Studies (CIRPAS), the Turbopropulsion Laboratory, the Combustion Laboratory, the Secure Space Systems Technology Laboratory, the Ocean Acoustics Observatory, the Virtual Environment Laboratory and the Center for Autonomous Underwater Vehicle Research and a diverse faculty with expertise covering a wide range of technical areas, are the core requirements for initiating and sustaining the Technology Transfer Program. Inherent to the academic environment is the pursuit of knowledge and as such, the faculty continuously strives to reach out and grasp the opportunities that enhance their programs. The tenure process at NPS also serves as an incentive for faculty to publish in the refereed literature of their discipline.

The Office of the Associate Provost and Dean of Research provides managerial and administrative support for the Technology Transfer Program. The OGC representative provides legal support and the NPS Research Board provides technical support.

Performance measures for the Technology Transfer Program will be more clearly defined within the next year. Outside of the performance measurements for the NPS Research Program and the scholarly activity of the faculty, there need to be criteria which lend itself specifically to Technology Transfer. The Associate Provost and Dean of Research, the ORTA and the NPS Research Board will undertake this initiative.

APPENDIX F

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Naval Technology Needs – Cross-Reference Codes (ONR, 2005b)

(From DoN Technology Transition Program Office– Office of Naval Research – March 2005)

Reference for Sponsoring Organizations:

CTTO: Commercial Technology Transition Office
NAVAIR: Naval Aviation Systems Command
NAVSEA: Naval Sea Systems Command
PEO AC: Program Executive Office – Aircraft Carriers
PEO SUB: Program Executive Office – Submarines
PEO C4I/S: Program Executive Office –Command, Control, Computer, Communications and Intelligence (C4I) and Space
MCWL: Marine Corps Warfighting Laboratory

Code	Technology Need	Sponsor Organization
T1	Computer Network Defense and Information Assurance	CTTO
T2	Innovative Technologies	CTTO
T3	Joint Combat ID - IFF and Blue Force Tracking	CTTO
T4	Persistent and pervasive ISR	CTTO
A1	Data fusion - information processing	NAVAIR
A2	Ocean sensors	NAVAIR
A3	Automated mission planning	NAVAIR
A4	Displays	NAVAIR
A5	High speed - high density over the horizon communications	NAVAIR
A6	Corrosion prevention and corrosion treatment	NAVAIR
A7	Obstacle and wire strike detection and avoidance	NAVAIR
A8	Voice recognition & voice synthesis -speech to text	NAVAIR
A9	Decision aids to reduce operator burden -collaborative tools	NAVAIR
A10	High density energy sources	NAVAIR
A11	Chem/Bio detection and decontamination	NAVAIR
S1	Autonomous Vehicles (Sea Strike)	NAVSEA
S2	Battle Damage Assessment (BDA) (Sea Strike)	NAVSEA
S3	Biological Threat & CBRN Detection / Decontamination (Sea Shield)	NAVSEA
S4	Cohesive, Coherent Digital Radar Development / Overland Radar (Sea Shield)	NAVSEA
S5	Combat ID (FORCEnet)	NAVSEA
S6	Common Operational and Tactical Picture Integration and Dissemination (FORCEnet)	NAVSEA
S7	CSGOA & AOA Clearance - Coverage Rate (Sea Shield)	NAVSEA
S8	Distributed, Collaborative Operational Logistics Planning and Total Asset Visibility (Sea Basing)	NAVSEA
S9	Heavy Lift Aircraft Technologies (Sea Basing)	NAVSEA
S10	Heavy Lift Surface Transport (Sea Basing)	NAVSEA
S11	Information Assurance - Fault Tolerant Processing & Networks (FORCEnet)	NAVSEA
S12	In-Port Air Defense Radar (Sea Shield)	NAVSEA

S13	Leverage National Sensors (Cueing & Targeting) (FORCEnet)	NAVSEA
S14	Littoral ASW Engagement (Sea Shield)	NAVSEA
S15	Long and Ultra-Long Endurance Survivable ISRT Assets (Sea Strike)	NAVSEA
S16	Modular Sea Power Systems (Sea Shield)	NAVSEA
S17	Over the Horizon - Beyond Line of Sight Voice & Data Communications - Multi-Path Redundancy (FORCEnet)	NAVSEA
S18	Real-Time Extensible Track Management in COTS Open Architecture Computing Environment (FORCEnet)	NAVSEA
S19	Sea Base Terminal (SBT) for Maneuvering Re-Entry Vehicles (MARVS) Mid-Course Inventory (Sea Shield)	NAVSEA
S20	Ship Robotic Interfaces (Sea Basing)	NAVSEA
S21	Small Boat Defense - Defeat Swarm Threats (Sea Shield)	NAVSEA
S22	Subsurface Swimmer Detection (Sea Shield)	NAVSEA
S23	Surface Combatant Damage Tolerance and Damage Control (Sea Shield)	NAVSEA
S24	Surface Combatant Signature Management Technology (Sea Shield)	NAVSEA
S25	Surface Connector / Interfaces Between Vessels (Sea Basing)	NAVSEA
S26	Topside Signature, Structure, and Sensor Integration (TSSS) (Sea Shield)	NAVSEA
S27	Underwater Cueing / Large Area Search (Sea Shield)	NAVSEA
S28	USW Collaboration (FORCEnet)	NAVSEA
S29	USW Self Defense (Sea Shield)	NAVSEA
	Enhanced Weapons / Material Movement	PEO AC
C1	Automated Material Movement	PEO AC
C2	High rate vertical/horizontal movement	PEO AC
C3	Compact Agile Mover (human amplification)	PEO AC
C4	Automated Warehousing	PEO AC
C5	Automatic Aircraft Tracking	PEO AC
C6	RFID tags – Safe to ordnance & electronics	PEO AC
	Design Enhancements	PEO AC
C7	Consolidated Energy Storage and Power Conversion	PEO AC
C8	Fuel Handling Automation	PEO AC
C9	High Power Electronics	PEO AC
C10	Advanced Cooling	PEO AC
C11	Hydraulic/ Electric Actuators	PEO AC
C12	Condition Based Maintenance	PEO AC
C13	Non-Invasive Inspections	PEO AC
C14	Sensors to assess coating wear	PEO AC
C15	Advanced Noise Reduction/Control	PEO AC
	Warfare Systems	PEO AC
C16	Reduced number of topside antennas	PEO AC
C17	Carrier Strike Planning and decision aids	PEO AC
C18	Network Systems Open Architecture	PEO AC
	Advanced Materials	PEO AC
C19	Lightweight Materials (Metal/Composites)	PEO AC
C20	Passive Jet Blast Deflector Materials	PEO AC
C21	Improved Surface Coatings and preservation techniques	PEO AC
C22	High Durability Non-skid	PEO AC
	Advanced Ship Self Defense	PEO AC
C23	Torpedo Defense	PEO AC
C24	Advanced Point Defense Weapons	PEO AC
C25	Advanced Force Protection Measures	PEO AC
C26	Directed Energy	PEO AC
	Ship's Force Service Improvements	PEO AC

C27	Training and Mission Rehearsal / Reconstruction	PEO AC
C28	Habitability/ Communications to home/ Quality of service	PEO AC
C29	Safety/Medical/Wound & Injury rehabilitation	PEO AC
U1	Renewable energy sources for all sizes of Unmanned Underwater Vehicles	PEO SUB
U2	Advanced motor control and device technologies (lightweight high efficiency)	PEO SUB
U3	Offboard sensors and sensor integration	PEO SUB
U4	Multi Level Security -Multiple Independent Levels of Security	PEO SUB
U5	Improved Computer Aided Detection -Computer Aided Classification (recognition)	PEO SUB
U6	High Power Transmission through pressurized boundary	PEO SUB
U7	AC Link Converter (lightweight)	PEO SUB
U8	Extended analysis and display software to surface and air platforms	PEO SUB
U9	Improved Ship Construction by expanding open architectures and software reuse	PEO SUB
U10	Mid Frequency sonars, recording and exploitation or element level data	PEO SUB
I1	Common, Persistent Maritime picture - Improving shared situational awareness across the force	PEO C4I/S
I2	Computer Network Defense and Information Assurance - Assured information	PEO C4I/S
I3	Ubiquitous communications and network infrastructure - bandwidth management - IPv6	PEO C4I/S
I4	Data link management & architecture - Improving data link throughput	PEO C4I/S
I5	Persistent and pervasive Intelligence Surveillance Reconnaissance	PEO C4I/S
I6	Joint Combat ID – Indication of Friendly or Foe and Blue Force Tracking	PEO C4I/S
M1	Over the Horizon, On the Move Voice and Data Communications	MCWL
M2	Persistent surveillance, actionable intelligence, battlespace shaping, precision targeting	MCWL
M3	Improvised Explosive Device (IED) Defeat - Prediction, Detection, Prevention, Neutralization, Mitigation	MCWL

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